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JOURNAL OF ELECTRICITY

POWER AND GAS

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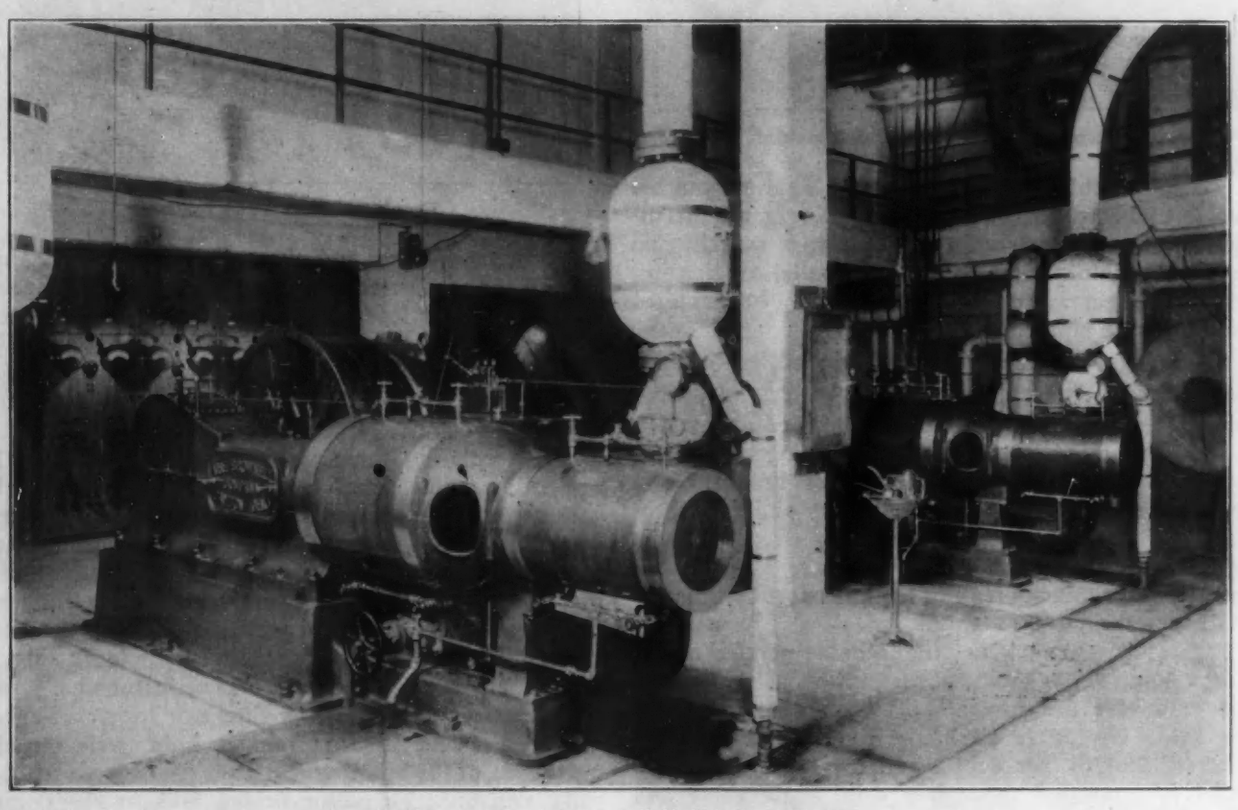
Y. M. C. A. POWER PLANT

BY B. H. BARBER

An interesting power plant has recently been installed in San Francisco's new Y. M. C. A. building, which for accessibility and general arrangement has received more than the usual attention from its designers.

The engine room is 61x58 ft. and 21 ft. high over the engines and boilers, a gallery running around two sides for the accommodation of visitors. A 5-ton chain tackle is hung from an overhead trolley which is carried directly over the main shafts of both engines and generators. The concrete walls and pillars are finished with white liquid stone paint, and as ample ventilation and natural lighting is provided, the usual heat and dark corners of a sub-basement engine room are noticeably absent.

The boiler equipment consists of three Franklin water tube boilers, each having 1046 sq. ft. of heating surface, and a commercial rating of 104 h.p. These boilers are arranged with an improved furnace for burning fuel oil, which is supplied from a 4500 gal. storage tank under the Leavenworth street sidewalk by a No. 3 Wilgus oil set. Wilgus burners are used, and evaporative tests have shown an average equivalent evaporation of 14.54 lb. of water from and at 212° per lb, of oil, for each boiler and while carrying an overload of 50 per cent.



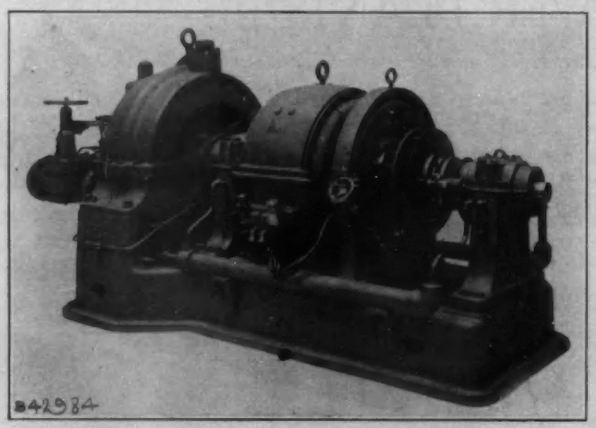
Switchboard and Engines in Y. M. C. A. Power Plant

Two Brownell 20th century automatic tandem compound engines, direct connected to 100 kw. Westinghouse 220 volt, three-wire generators and one Westinghouse 100 kw., 220 volt, three-wire turbine and generator supply the current for the lighting and power service of the building.

The engines are 10 in. and 17½ in. x 15 in. stroke and at 250 r.p.m. with 125 lb. pressure at the throttle with 1/3 cutoff develop about 155 i.h.p. each. The governors on these engines are of the Rites inertia type

and extremely sensitive to sudden fluctuations of load.

Upward of 4000 Mazda lamps of from 25 to 100 watt capacity are used throughout the building, while the power load consists of three passenger elevators, one service elevator, one sidewalk elevator and five fan motors. Current is used at 220 volts for the elevators and fan motors, while equalizing transformers take care of the unbalanced lighting load at 110 volts. The elevator service is severe, often imposing swing loads of 90 per cent to 100 per cent of the normal being carried on the engines and as often as five times in a minute. The engines have been able to handle this variable load in a very satisfactory manner.



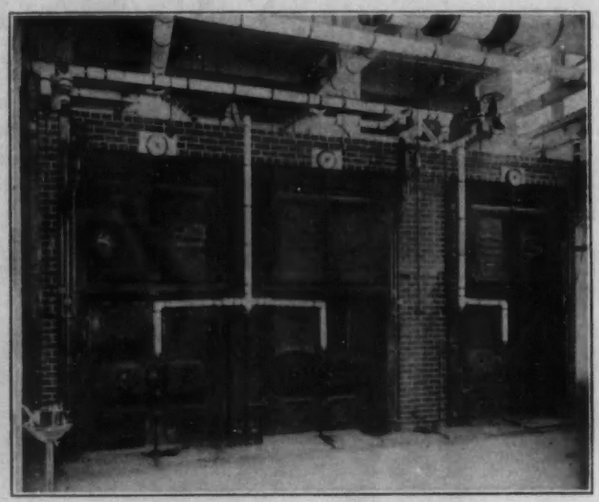
100 kw. Westinghouse Turbo Generator.

The switchboard is built of blue Vermont marble and is mounted with standard Westinghouse instruments and arranged with double throw switches so that all machines may be run in parallel on lighting and power service or each service can be supplied from separate units.

Break down service is also supplied, to be used in case of emergency, a specially constructed switch being used to throw over the d.c. service and which makes contact on one side before letting go on the other, which insures that the circuit breakers and potential switches on elevator motors and fan rheostats will not go out when changing over. This is important, as the elevator machines are all overhead and any momentary break in the current would necessitate resetting all potential switches. A separate voltmeter is supplied on the outside service and a plug connection is provided for cutting in the swinging voltmeter for comparison when changing over the load. Piping is all hung from the ceiling and covered with 85 per cent magnesia covering. Each boiler is connected through a 5 in. angle valve and pipe to an 8 in. main header; 5 in. long radius pipe bends with stop valves lead from the top of this header to each engine. Crane separators are used over each throttle, all draining to a common trap which discharges into the feed water heater.

A 4 in. auxiliary header extends across the tops of the boilers, and supplies the oil set, vacuum cleaning machine, two well pumps, two Spring Valley pumps, two vacuum return pumps, feed pumps and salt water circulating pumps. Steam is also supplied from this header to a 350 gal. direct water heater for the kitchen supply; through a reducing valve to the cooking kettles in the kitchen and to the laundry on the ninth floor. This auxiliary header is also connected to the main header through a 4 in. angle valve which is ordinarily kept closed. Steam for the oil burners is supplied by a separate 1¼ in. connection to each boiler so that the burners are not affected by the supply of steam to other places.

The exhaust and drain pipes are carried in a trench at the rear of the engines. An extra large vertical oil separator is provided to catch all entrained oil. From this separator the exhaust is carried to two large



Franklin Water Tube Boilers.

fresh water heaters and the salt water heater, then carried up as a riser through the building, to which all the radiator leads are connected. The back pressure valve is at the roof and is set to maintain 2 lb. pressure on the heating system. All condensation possible to recover is drawn back through the vacuum pumps and returned to the feed water heater.

A circulating pump passes the salt water from the swimming tank through a pair of Jewel filters and the salt water heater, returning it to the plunge at a temperature of 80 degrees. All water for flushing purposes, etc., is obtained from six wells under the building, while Spring Valley water is used for cooking, drinking and boilers, all except that used in the boilers being passed through Jewel filters before using.

Ventilation for the auditorium, lecture halls and class rooms is controlled by direct, indirect radiation, fresh air being drawn from a light well on the north side of the building and after passing over steam coils, delivered by motor driven fans in the engine room to the various points as required. Exhaust fans are also provided to insure a constant circulation throughout the system.

McDougall Bros. were the architects of the building, Mr. Harry Leavitt acting as their consulting engineer. Mangrum & Otter installed the heating and ventilation system and all piping in the plant, the Compressed Air Machinery Company being the contractors for the installation of the boilers, engines and generators.

THE GASIFICATION OF PETROLEUM.

BY E. N. PERCY.

The manufacture of gas from petroleum for illuminating purposes is mainly accomplished by spraying the oil either on to a white hot surface, into a very hot space surrounded by incandescent surfaces, or both. The factors entering into action under these conditions are the element of the specific heat of the gas and of the oil-brick or other heat reservoir, the element of time, and the element of temperature.

Eliminating Pintsch and other retort oil gas processes, and assuming fire brick heat storage, now in general use, we can assume that the specific heat factor is fairly constant under all gas making conditions.

While the composition of acceptable illuminating gas is somewhat complicated, and while there are many mixtures that are perfectly acceptable under the name of illuminating gas, it is probable that oil gas of this nature may be made within narrow limits of temperature, if so desired. Extremely high temperatures tend to resolve oil into ultimate hydrogen and carbon. Gas making, as practiced, is intermittent, and some engineers insist on high heats, making a gas high in hydrogen at first, and tailing out the run until enough fat gas is made at the end to bring up the candle power to the desired 20 or 22. Others use a more moderate heat, and produce a gas that is almost right all the way through, stopping the run before the gas becomes too rich and tarry.

The element of time has two sub-factors, one is the absolute time necessary for the oil vapor to be brought up to the cracking point, and the other is the time occupied by the vapors and gases in gaining an opportunity to become heated; this is explained by describing illuminating gas as a compound in which certain parts, like hydrogen, and methane are thoroughly heated, while other parts are less completely broken up, although passing through at the same time.

Every compound has a critical temperature. If it is formed above this point it will break up exothermically below it; if it is formed below this point it will break up endothermically above it. A complicated substance like oil contains compounds of many different critical points, hence no gas apparatus can ever even approach theory in action, but merely operate as a sort of an averaging contrivance. To illustrate this point, suppose oil and steam be sprayed into an incandescent chamber. The oil splits into hydrogen, carbon and other compounds. The steam splits into hydrogen and oxygen. Writers have frequently shown how theoretical temperatures may be calculated, and explained why we never reach them; but a little reasoning shows that regenerative furnaces of any type should greatly exceed these temperatures. They do, but not to the extent indicated by reasoning and figures. This has caused the writer to reason that the calorific value of substances decreases as the temperature rises. For instance, hydrogen and oxygen combine, giving off great heat, and their theoretical temperature is their critical temperature. Above this temperature, they will not combine, indeed, they are separated by heating above this point. Is it likely that this is a sudden change? Is it not likely that the calorific value of hydrogen gradually decreases as its temperature rises, until at critical temperature, it is incapable of combining with oxygen, and above this temperature its calorific value is even negative? On the other hand, take a substance like aluminum, incapable of oxidizing below a certain temperature, yet doing so easily above this temperature, and acting exothermically as an oxide compound, below this temperature.

Returning to the gas generator, the carbon has a specific heat many times that of hydrogen, also, is many times in excess, by weight, hence much cooler. The carbon has not had time to heat to the critical point, and at the moment of liberation, every atom is surrounded by films of highly heated nascent hydrogen, which oxidizes the available oxygen, the moment the temperature falls below the hydrogen critical point, but not with very great affinity nor great heat, because they are close to the critical temperature.

The net result is that when oil and steam are thus mixed, carbon monoxide will not be formed, as is well known to be the case.

Returning to the question of oil, the general characteristics of oils used for gas making are:

Gravity Beaume.	% C.	% H.	Calorific Value.	Heat Units Per Gal.
26	84%	13%	19,566 B.t.u.	146,530 B.t.u.
14	86%	11%	18,600 B.t.u.	150,660 B.t.u.

The heavy oil has 3 per cent more carbon, 30 per cent less hydrogen, and about 3 per cent more heat for the money paid out; but only 10 per cent or less of the oil is used for heating purposes in gas making, while over 90 per cent goes to make gas.

Now oil, in general, contains about 12 per cent of hydrogen. The following is a typical analysis of illuminating gas, made from oil only:

Benzol.....	0.90	Combustible	89.90
Illuminants.....	4.23	Noncombustible ..	10.10
Monoxide.....	4.23	Candle power.....	18.31
Methane.....	33.76	B.t.u. 633.5	
Hydrogen	46.78		
Dioxide	1.00		
Oxygen	.50		
Nitrogen	8.60		
	100.00		

Calculation indicates that an ultimate analysis of such a gas results in about 25.8 per cent hydrogen, and 74.2 per cent carbon, the remainder consisting of miscellaneous matter.

The gas has twice as much hydrogen as the oil, and ⅞ as much carbon. A simple calculation shows that about 2 lb. of oil are required to make 1 lb. of gas, with ¾ lg. lamp black over, amounting to ⅜ of the weight of the oil used, or 30 lb. of lamp black per thousand feet of gas, on a basis of 10 gallons per thousand. This agrees closely with practice. In addition to this, in practice, there is much tar formed. Tar represents dead loss, because it contains hydrogen, and this loss is, theoretically, unnecessary; practically, it cannot be avoided with a heavy oil, but a light oil forms almost no tar, when rightly used.

Therefore, in buying heavy oil, which contains 30 per cent less hydrogen, of which there is never enough, and 3 per cent more lamp black, of which there is always an excess, the gas man is buying a material 33 per cent less suited to his wants because it is 10 or 20 per cent cheaper. In addition, it clogs his generators,

requires heating, etc., and is very much more difficult to handle.

Where the lamp black is used in a water gas plant, a notable saving is accomplished, but it is an expensive process from a labor standpoint, and a light oil would accomplish a large part of the same work in the original generator set.

The carbon to hydrogen ratio in illuminating gas is approximately 1 to 3, by weight. In light oil, it is 1 to 6.5, and heavy oil, 1 to 8. In small gas plants, the waste lamp black is used to heat the boiler. The writer favors using it in some simple type of producer to heat the oil checkers, in fact, a modified water gas plant, using mostly oil, and just enough water gas to utilize lamp black. The boiler should be run on gas (in small plants only), as it would enable the plant to run more steadily, consequently, more economically. It is easier to control a gas fire under a boiler, and it starts without trouble in a cold furnace. The gas itself is made much more economically, since the lamp black heats the checker, and the set runs more continuously, and seldom cools down.

A moment's inspection of the hydrogen carbon ratio of any gas, even a monoxide water gas, shows that it is not possible to manufacture a satisfactory illuminating gas that will contain all of the carbon in oil; but if all the heating be done with carbon, and carbon only, and the same fuel be utilized for water gas, it can all be used, even in the largest plants; but it hardly seems necessary to separate the plants. Why not operate a modified water gas set so as to run principally on oil, as stated before?

Assuming that 3/8 of weight of oil goes to lamp black, and that 10 per cent of oil is used for heating purposes, we have a heat balance as follows:

1 lb. of oil....18,600 B.t.u.	3/8 lb. of lamp black....	5,450 B.t.u.
	1/10 lb. of oil.....	1,860 B.t.u.
	17.8 cu. ft. of gas.....	11,290 B.t.u.
		18,600 B.t.u.

Assuming 8 lb. per gallon, we have 7.7 gallons as the amount of oil necessary to make one thousand feet of illuminating gas as above.

The amount of lamp black agrees closely with practice. The oil for heating varies from 5 per cent in large sets to 30 per cent in small sets. As is well known, 9, 10 and 11 gallons are actually used, and the question arises, Where is the waste? It cannot be the heating oil, or waste of heat, because that is included in the 10 per cent. It cannot be in lamp black, because there is nothing to combine with it; therefore, by simple elimination the losses are traced to hydrogen. As all free hydrogen is saved, it must be in the form of a compound, and is quickly found in the tar. Tar, while a complex and variable substance, is very rich in hydrogen. A quart, or a gallon of tar per thousand feet of gas does not appear to be much, but when mentioned in terms of oil, it frequently accounts for 10 per cent or more. The writer tested one small plant using heavy oil, and in about two weeks, while using 10,000 gallons of oil for gas making and a small steam boiler, it filled a wash box 36 by 72 in. three-quarters full of solid tar, which, no doubt, contained free carbon. Immediately afterwards, a light oil of 30 Beaume was started, and practically no tar made thereafter. There was apparently more lamp black, but this was because it was lighter and fluffier, but weighed less. The amount of oil per thousand feet of gas made dropped more than one gallon; but it must be borne in mind that the light oil must be handled properly, or no gain will result. It will be necessary to use more for heating purposes, not because it has less calorific value, but because there is less, in fact no carbon, left in the set to burn out. Light oil must not be put through too much brick work, and should be forced or drawn through the set quickly, for two reasons, first, that the gas may not be cooked too long, breaking up illuminants and destroying candle power, and secondly, that it should issue at as low a temperature as possible after being made, for economy's sake.

When the writer began oil gas making on this Coast, it was a new subject to him, and he approached it unbiased, and made several years' tests and observations in that spirit. After much thought and study, he is still unprepared to favor any apparatus or system, and refers to their peculiarities merely as his personal observation.

Numerous tests and records of tests of long machines of U type, H type or horizontal type show invariable economy in heating; that is, from ½ to 1 gallon per thousand feet of gas to heat the set. Short machines, such as used in small towns, or single barrel machines used anywhere show less economy in heating; that is to say, from 1 to 4 or 5 gallons per thousand feet of gas for heating set.

The long machines which make gas throughout the whole length show less economy on the gas making cycle, that is to say, they use 9 to 12 gallons for making gas.

The long machines which heat throughout, then make gas from both ends to the middle or both ends to some intermediate point are more economical on the gas making cycle, running 8 to 10 gallons.

The short machines, single barrel type, with short checker brick, not more than 4 to 6 ft., invariably are the most economical on the gas making cycle, running from 7 to 9 gallons per thousand feet.

The net result of all these tests is to show that to obtain the best results, a gas machine should be long for heating and short for gas making. This at once brings up a type that fires straight through, then makes gas from both ends to the middle, or both ends and middle to two take-offs.

It is almost impossible to calculate the amount of heat necessary, theoretically, to make gas; because, in the first place, it varies greatly, and in the second place, the calculation is too much involved. Some of the best records for heating run about 3 per cent of the total oil used, when running on an 8-gallon-per-thousand-feet basis. This is pretty good running. The issuing products of combustion were at a temperature of 2000 degrees F., roughly measured, indicating a furnace efficiency of about 50 per cent. This indicates that about 22,000 B.t.u. are required to make 1000 ft. of oil gas under commercial conditions. This figure must be divided by furnace efficiency, and any other unusual factor entering into the process.

The temperature is equally uncertain, and, probably variable, but several tests have established that at 2000 degrees F., a set will make satisfactory illuminating gas of 18 to 20 candle power, while if much

cooler than this, there is an increasing amount of tar and increasing candle power. As the temperature of combustion is from 3500 degrees F. upwards, and the brick are left at temperatures in excess of 3000 degrees after each heat; it is safe to assume a temperature range of 1000 degrees, from 3000 down to 2000 in all calculations of time, capacity, etc., as the results are pretty certain to exceed these figures.

The specific heat of brick is .2, and the weight 145 lb. per cubic foot, therefore each cubic foot is capable of storing 29,000 B.t.u. when heated 1000 degrees F.; but there is another factor that enters and is the most important of all. The factor of conductivity of brick is 1/83 that of copper; which means that for each degree difference of temperature, brick can only transmit 14.5 B.t.u. per hour per square foot of surface. With a thousand degree temperature range, amounting to an average difference of 500 degrees, each square foot of brick exposed to the heat can absorb only 161 B.t.u., and if the amount of oil to be burned during the heat is known, it is simple to calculate the amount of brick that should be exposed to it, and the length of the heat. Several checks by the writer show results corresponding closely with practice, where economy is obtained, but not otherwise.

There are several complex phenomena that enter in addition; they can be partially calculated, partially judged by horse sense, and help to explain some of the peculiarities known but not understood by every practical gas maker.

First—The heat gradually creeps to the interior of the brick, but will not become high, except after 20 or 24 hours' run. If a white hot brick be broken, one will be surprised at the coolness of the interior; still, after a day or two steady running, bricks get heated throughout, but the heat thus stored does little good, on account of the slow conductivity, and is usually radiated, after the day's work is done. Most of the heat for gas making is stored in the first quarter inch of the brick, and the skin of the brick does practically all of the work. To be sure they become heated through, and thoroughly carbonized, but instead of arguing, let the interested party remove a white hot checker brick after the first or second heat and break it quickly, and note the result. This is why a set with ample amount of brick work, heated slowly by a not too hot flame makes gas long and easily on the run, while a quick sharp heat only touches the skin, the run is short and strenuous, and as much heat strikes into the checker and lining as comes out to the gas, and the day's run may be over before returns are realized from the slowly heated brick.

Second—The radiation losses of an idle set are worth studying, since they are so easily measured. A small country set that runs about eight hours a day, making say 15,000 ft., will require 12 to 20 gallons to heat, or in other words, that represents the radiation. This opens up a field for thought in the lagging of gas sets, since their shell temperatures are relatively high, and radiation losses are large.

Third—There is the time element in heating. It would be easy, by tests, to establish a time basis, in seconds, that is necessary for oil to absorb the necessary amount of heat from brick, drop its carbon and gasify. This brings up another point of interest. From his experience with gas engines and oil gas generators for power purposes the writer is inclined to think that when oil strikes a white hot surface, it drops much carbon, and cracks to either pure hydrogen or very light hydrocarbons, while if it merely comes into a hot atmosphere, or receives its heat by radiation only, it drops less carbon, and forms much heavier and richer hydrocarbon gases. In other words, by having less checker brick, but more tube or lining, the oil would be just as thoroughly cracked, and gasified, but the gas would be of higher candle power, with less pure hydrogen, incidentally, suitable to mix with a monoxide, and carrying a larger percentage of carbon, which is another advantage.

Fourth—A correction which must always be made is for the latent heat of evaporation of the oil, amounting roughly to 220 B.t.u. per pound of oil.

Fifth—All of the reactions of oil gas making are endothermic. The net efficiency of oil gas apparatus varies from 25 to 60 per cent exclusive of lamp black and tar. By using the carbon or lamp black for heating the oil gas set, it would seem that an efficiency could be obtained comparing with coal gas producers making monoxide, and, in addition, a simple type of generator developed.

Sixth—The specific heat of illuminating gas is about .45, while that of hydrogen is 3.4. When an excess of hydrogen is formed, and as gas consists of half hydrogen, or more, the generator is cooled down quickly, until the illuminants are increased, thus, to a slight extent, an excess of hydrogen acts against itself. As every gas maker knows, a gas high in hydrogen takes more heat than a richer one.

Referring again to brick, it would seem as though cast iron could be used as a heat reservoir in gas sets, protected, of course, by a coating of brick, to prevent oxidation. The specific heat is .12, hence while it theoretically could not store as much heat, it would really store much more than brick, because of its high conductivity, resulting in quicker heating, longer runs, and greater economy.

The specific heat and conductivity of carbon and lamp black are about the same as brick, hence carbonized brick ought to be as good heat reservoirs as clean brick; as a matter of fact, the writer has never had it satisfactorily proven that well shaped carbonized brick should be thrown away, yet it is done right along.

Lamp black is made when the oil cracks into gas in a suspended condition from radiated heat.

Coke is made when the oil impinges directly on an incandescent body, or runs continually to one place and is evaporated by radiated heat to a solid residue.

Both of the above phenomena have been actually witnessed by the writer when oil was sprayed into a white hot reverbatory furnace, with the air shut off. After spongy coke, full of hydrocarbons is made, if the blast be turned on it, it will become incandescent, and burn slowly. In the course of time, it becomes very hard, of a bright silver color when cold, and very difficult to remove from the generator.

Lamp black, "sponge," asphaltum, etc., burn out easily with a strong blast, particularly if carefully done every time; but an accumulation of hard coke, once

started, stays incandescent, therefore cokes everything else that comes its way, and soon clogs the machine, because hard coke cannot be burned out in a puff like sponge coke, and the hydrocarbons usually known as "carbon in machine," and which vaporize as much as they burn, as is evidenced by the clouds of green smoke when the stack valve is lifted and blast on before, or even after, oil is on.

Under the conditions of heat, etc., favorable to many endothermic reactions, are formed carbides of iron, silicon, calcium, otherwise known as acetylene, sulphur, and copper, resulting in the weakening of metal structures, forming of explosive compounds and many other phenomena that appear mysterious to the worthy, practical man. The writer had the experience of throwing a few discarded brick into a vat of water, and seeing a perceptible amount of acetylene gas arise; not enough to light, but of unmistakable and characteristic odor.

Steam in the generator has many peculiarities. Assuming it to have been broken up into its elements, the oxygen will combine with white hot lamp black under the conditions previously set forth, but not with cold carbon. It is doubtful if heavy lodged coke is particularly active in any capacity, as the activity of carbon seems to depend upon the temperature and surface exposed, as in floating incandescent lamp black, which is really luminous flame.

Several types of machine taking off at the bottom, take in steam at the top, and oil half way down. They make the usual satisfactory illuminating gas. The writer has reversed the connections putting the oil in at the top, and steam in the middle. The oil gas was, obviously, made first, with attendant incandescent lamp black. The steam being broken up, went to monoxide in the usual way, and the percentage of monoxide was very much increased; whether desirable or not is another question, since it was purely an experiment.

Extensive experiments with the ordinary water gas set, as used for coke and coal in the East, show that 25 per cent of the gas is furnished by the oil. If all the gas were furnished by the oil, it would require about 8 gallons per 1000 ft., agreeing closely with our best practice. About one-seventh of the oil goes to tar. The operating temperatures are 1500 to 2000 degrees F. A great many very complete tests indicate that the latent heat of gasification of petroleum is about 400 B.t.u. per pound of oil. This is equivalent to about 13,000 B.t.u. per 1000 ft. of gas; but pure oil gas of the type used to carburet water gas consists almost entirely of hydrocarbons, and practically no hydrogen uncombined, and is, therefore, of high candle power. When making straight oil gas, it is cracked up to a higher point, liberating 40 to 45 per cent of free hydrogen, and cutting candle power down accordingly. This requires more heat, since the equations are all endothermic for the breaking down of hydrocarbons, without oxidation. The 13,000 B.t.u. will have to be raised. There have been no tests on oil gas machinery that have been made with sufficient care to establish this figure, since it can be established by elimination only, but putting this with our former reasoning, the amount of heat necessary is placed somewhere between 13,000 B.t.u. and 22,000 B.t.u. per 1000 ft. of gas. This corresponds to ⅛ to 1/16 of a gallon of oil per 1000 ft. for heating purposes. With a fair allowance for furnace efficiency, we are probably about as near to the theoretical figure as present available data allows us to approach; for purposes of calculation, it may be taken at 18,600, or the same as heavy oil. This makes a convenient figure, and there is such wide latitude in generator design, that the figure will serve all practical purposes, since it is equivalent to saying that 1 lb. of ordinary petroleum, working at 100 per cent furnace efficiency, can heat for the manufacture of 1000 ft. of gas. This figure would indicate that average generator efficiency on the heating cycle is about 30 per cent or less, which is probably about true.

Carbureted water gas is about the same as illuminating gas, except that the methane, monoxide and free hydrogen together occupy the volume occupied in ordinary illuminating gas by the methane and free hydrogen alone.

Either practical experience or calculation teaches us that in a water gas process, the carbon can furnish any amount of heat in proportion to amount used, and can gasify any amount of oil, and that there will always be an excess of carbon, if the oil gas be in the majority, yet with candle power held at 20. This means that money is saved by using carbon for heating and for monoxide. Also, it means that money is saved by adding a gas making material that contains no carbon, but hydrogen and oxygen with a capacity for taking up some of the extra carbon.

In other words, oil costs money, lamp black and water cost nothing (to the gas maker).

Therefore, why not use oil for just three things—the illuminants, the carbon and the methane.

Now use the carbon to heat checkers, and to make water gas, and pure water furnishes hydrogen and monoxide.

At first thought one would say that is merely water gas, but the idea is to increase the heats and oil, until oil gas and carbon are produced, to continue the heating. Of course the oil would have to furnish some hydrogen, in order to maintain carbon supply.

There is no special advantage in water gas unless there be some economy in its manufacture. The thermal economy is one possibility, and the use of water instead of oil another. It would seem as though the logical oil water gas plant would be a three-section checker heated by producer gas from a carbon set. Into one checker set put oil, and let it break to illuminants, carbon and some hydrogen. Into the second, let the steam be run, and split to hydrogen and oxygen. Let them combine with the lamp black in the third chamber, forming monoxide. As the action is exothermic, no checker is needed, and the combination takes place, with an evolution of heat, which increases the sensible heat of the gases, helps to crack up a few of the remaining heavy hydrocarbons, and is lost, unless the time comes that engineers use stack devices for saving such losses, which are not as large as they appear, because, in the first place, the specific heat of gases, referred to water, is very low, and the actual amount of sensible heat is small, because the total fuel

used for gas making is small compared to the fuel gasified.

If the products of combustion are analyzed, they should result about as follows:

CO_2, 13.8 to 14.5; CO, 2.5 or less; O, 2.5 or less; N, 81.6 about.

If the CO_2 is much less, or N much less, it indicates excess air. If the CO is high, it is a positive indication of too little air. If any hydrogen whatever is present in more than, say, 1 per cent, it is an indication either of faulty combustion, or very high stack temperature, or both. In considering it, one must bear in mind that critical temperatures and amount of air are both factors with hydrogen. When a generator is smoking a little, it is heating more economically than when the top is clear, because, first, if there is some smoke, there is not apt to be excess of air, while if the top is clear, there is apt to be great excess of air. When a generator is rather cool, and covered with tar, or heavy oil, and tarry carbon, nothing will keep it from smoking, because the heat is breaking down the hydrocarbons, yet is not hot enough to ignite them; but as the heat progresses, they will be observed to ignite. The heat is then said to have "come up." Frequently, when this is the case, and a little oil is turned on, enough to carry the flame up, with plenty of blast, the escaping hydrocarbons and free carbon will ignite, and burn brightly, if the oil be turned off again.

It is poor economy to have an excess of air for two reasons. In the first place, it is very easy to have 200 or 300 per cent more air than needed, and every 100 per cent going out of the stack at 2000 degrees temperature takes 20 per cent of the amount of heat that is really necessary, as a simple calculation will show; second, an excess of air, with strong draft, gives a sharp, quick heat, hard on the brick, and, bearing in mind their slow conductivity previously referred to, the heat is over more quickly, but less heat is stored, since it is all in the skin of the brick.

Steam is an obedient servant in placing a heat, and the writer has often marveled that gas makers are not more fully instructed regarding its use. Any generator tends to get hottest near the actual point of combustion, and excess air, with all its evils, or too little air, with its slow combustion, or other imperfect methods are used to "place" the heat. By the simple addition of a steam pipe to the blast, the writer has been able to draw the heat to any part of the generator. With any kind of blast or fire, after the nearer part of the generator is heated thoroughly, then the steam is turned in. Splitting it up absorbs heat from the overheated part, and it restores this when recombining in the tail end of the generator. Also, if put in with the fire, it lengthens out the combustion, partly by chemical action, and partly by physical, until it is perfectly possible to superheat the tail end of the generator, while the near end is not as hot.

The blue or Bunsen flame is believed by many to be the perfect combustion. This is a grave mistake. In the first place, the Bunsen burner of any kind, if burning a luminous gas with sufficient air to burn blue, has a great excess of air, with attendant losses as referred to. In the second place, it is well established that a luminous flame gives off more heat than any other for two reasons; having less air, it can burn at a higher temperature, and its luminous hydrocarbons, although absorbing heat while breaking up, return it in the form of radiant energy or heat, and radiate powerfully to any surrounding substance. This radiation is little understood, but is an important factor in a flame. The blue flame is clean, and keeps the bricks clean because of its oxidizing action with excess highly heated oxygen. Luminosity is caused by the breaking up illuminants, and the incandescence of their carbon in a finely divided state. While not as hot as the surrounding gases, the heat has more mass, or rather, the carbon has, more resisting power, more ability to transfer its heat by radiation and convection. The reason a Bunsen is not luminous is because the carbon never exists as carbon, but passes directly from the hydrogen atom to the oxygen atom which has already been carefully mixed and heated, with several extra ones handy, also heated.

To exemplify this, put a blue flame rose burner in the middle of a cold room. It has hardly any effect, yet the heat must go to the room. It goes in a narrow, highly heated path to the ceiling, and warms the ceiling only. Now put a sheet iron stove over it, and the radiating surface makes the whole room warm. Now remove the stove and put a pan of boiling water on. The room is again warmed by the steam, which has less temperature, but greater mass of heat, and greater ability to radiate. Now remove them all, and cut down the air supply until the flame burns bright yellow, yet without smoking. It will act very much as the stove did.

A yellow flame will heat a room more economically and can do it without radiating surface, which a blue flame cannot. Its action in the generator is sharp, because the inner cone, or reducing flame, is hot, while the remainder is cooled off heating the escaping excess air; and the writer will venture that excess air is found in any blue flame, wherever used.

Of course, this does not refer to those gases and substances that burn naturally with a blue flame.

As electricity is becoming cheap, and as it is demonstrated that it can be used to maintain carbon at a high temperature, the writer hopes to see a gas generator developed in which the temperature is maintained by electrical means, and carbureted water gas made by a continuous process; thus offering great inducements to electrical companies already in the business, cheapening gas plant attendance, and allowing holders to be much smaller. The writer has done some experimenting along this line. It is hoped that nothing in this article will be construed arbitrarily, as it is written in the spirit of personal observation and understanding only, not as irrefutable facts.

Leasing of water-power sites instead of a revocable permit has been approved by President Taft and is to be the subject of Congressional action in H. R. 32,399 introduced by Mr. Parsons on February 2. Leases are proposed for 50 year periods and are irrevocable except for breach of conditions or of the regulations established which are not inconsistent with the lease, or for charging higher rates for power than may be established by the State. No lease is to be granted to or held by any trust.

PRECAUTIONS FOR HANDLING EXPLOSIVES

Miners' Circular No. 1, the first of a series to be written in plain, non-technical language for the benefit of the miner has just been issued by the Federal Bureau of Mines. It contains the names of the permissible explosives tested by the bureau at its Pittsburg station up to November 15, 1910, and gives precautions as to their use. Permissible explosives give a short and relatively cool flame that is less likely to ignite inflammable gas or coal dust than is the longer and hotter flame of dynamite or the longer and much more lasting flame of black powder. Because they can be used with greater safety, permissible explosives have taken the place of other explosives in many coal mines in the United States during the last two years and their use is increasing rapidly.

To reduce the risks in storing, thawing and handling explosives at coal mines, the following precautions are urged by the Bureau of Mines:

Don't store detonators with explosives.

Don't open packages of explosives in a magazine.

Don't open packages of explosives with a nail puller, pick or chisel.

Don't store explosives in a hot or damp place.

Don't store explosives containing nitro-glycerine so that the cartridges stand on end.

Don't repair a magazine until all explosives are removed from it.

Don't use permissible explosives or other explosives that are frozen or partly frozen.

Don't thaw frozen explosives before an open fire, in a stove, near a boiler, near steam pipes, or by placing cartridges in hot water.

Don't put hot water or steam pipes in a magazine for thawing purposes.

Don't carry detonators and explosives in the same package.

Don't handle detonators or explosives near an open flame.

Don't expose detonators or explosives to the sun for any length of time.

Don't open a package of explosive until ready to use the explosive, then use it promptly.

Don't handle explosives carelessly.

Don't use more than 1½ pounds of any permissible explosive for one shot in a coal mine.

Don't use a detonator (blasting cap) or electric detonator of less strength than No. 6.

Don't crimp a detonator (blasting cap) around a fuse with the teeth.

Don't economize by using a short length of fuse.

Don't use a metal tamping rod. A copper tipped rod is not to be recommended. Wooden rods are safer.

Don't use two kinds of explosives in the same drill hole.

Don't return to the face until at least 5 minutes after a shot has been fired.

Don't breathe the gases from the shot.

Don't return to the face after a misfire for at least one-half hour.

Don't attempt to draw the charge in case of a misfire.

Don't leave any detonators or explosives in a mine over night.

Don't charge or load any hole which has not been properly placed or has been drilled "on the solid."

Don't light the fuse of dependent shots at the time the first shot is lighted.

Don't expect to get satisfactory results with a permissible explosive or any explosive when a miner uses it for the first time.

Don't think the use of permissible explosives can take the place of other safety precautions in mines and thus neglect those precautions.

WOOD PRESERVING WITH ASPHALT OILS.

In a paper before the Wood Preservers' Association's meeting on January 19, 1911, Mr. Frank W. Cherrington describes experiments made and results obtained in the treatment of wood with asphaltic oils for the purpose of preserving it. In 1885 a committee on wood preserving of the American Railway Engineering and Maintenance of Way Association reported that crude petroleum would prove a preservative so long as it continued to saturate the wood by exclusion of water, but that the evaporation of the volatile oils rendered it useless for this purpose. Mr. Cherrington states that this report was based upon experiments with eastern paraffine oils, which are not stable in their composition. In 1901 the Santa Fe Railroad injected California asphaltic crude oil into pine ties and "laid them in a section of track in Southern Texas, where the climatic condition is one of the most severe for ties to be found in North America. A maximum quantity of oil was forced into these pine ties, the absorption per tie being, of course, dependent upon the amount of heart and sap wood in each tie." Oils from other sections of the country than California or Mexico were reported by the author to be too volatile and highly inflammable for this purpose in their natural state, but they can be refined to a desirable consistency.

Other experiments made on cross-ties were described. It was concluded from these that fairly good penetration could be secured in the various oaks, beech, gum, etc., when injecting all the preservative that the ties would absorb, this maximum amount being found to be about seven pounds per cubic foot. Short leaf pine ties were found to readily absorb straight asphaltic oil in larger quantities and with thorough penetration.

Other experiments were made with mixtures of 25 per cent of creosote and 75 per cent of asphaltic oil, and these appeared to demonstrate that the two substances remained mixed while penetrating the wood, and that a very satisfactory penetration was secured by the mixture.

"It is readily admitted that the only value of asphaltic oil obtained from the central United States as a wood preservative would be by the injection of a maximum quantity of oil into the wood." It is stated that in the test of ties so treated by the Santa Fe Railroad, nine years' test has indicated that where maximum saturation had been obtained the ties had been well preserved during this time. Nothing is stated by the author to indicate that any actual test has ever been made of the use of this material as a preservative for wood paving blocks, but we believe it is the intention of the asphalt companies to demonstrate its value for this purpose.

HOME TELEPHONE BANQUET.

In celebration of San Francisco's success in gaining the Panama-Pacific Exposition, employes of the Home Telephone Company of San Francisco recently held a big banquet at which 200 guests were present.

Many speeches were made, all of a congratulatory nature, and promising the most enthusiastic support in making the affair the biggest one of its kind ever held. The toastmaster of the evening was N. J. Prendegast, who sounded the keynote in a felicitous address. Among the other speakers of the evening were Dr. H. L. Hall, manager of the Oakland branch of the company; P. W. Alexander, A. McFarlane, S. Baer, John Wicks and William Henderson.

Home Telephone Banquet.

TUNGSTEN, TITANIUM, AND TANTALUM.

Although the figures from all the countries producing large quantities of tungsten are not yet available, enough are at hand to show that the world's production for 1909 was larger than in 1908, and was possibly equal to that of 1907. The estimated output for 1909 was 5289 short tons of concentrates containing 60 per cent of tungsten trioxide, compared with 3898 tons in 1908 and 6062 tons in 1907. In very few of the returns, however, is the percentage indicated, and this is necessary in comparing figures. It is probable that most of the exported ore is richer than 60 per cent in tungsten trioxide, and that the figures are therefore low. The principal sources of the 1909 productions were: United States, 1619 tons; Argentina, 900 tons; Australia, 1200 tons; Bolivia, 168 tons; Germany, 106 tons; Portugal, 609 tons; and the United Kingdom, 421 tons. The value of the tungsten ore produced in the United States during 1909 was $614,370, compared with $229,955 in 1908 and $890,048 in 1907. With the recovery of the American steel trade during 1909 prices rose above those of 1908 and ranged from $5 to $9 per unit for tungsten ores, the average price being $6 to $6.50 per unit.

So far as known, the rutile (titanium oxide) deposits at Roseland, Va., are the largest in the world. The use of titanium in making steel rails increased considerably during 1909, and an American railroad which has given rails treated with ferrotitanium a long trial reports that they are proving entirely satisfactory. The use of titanium in arc-light electrodes is also growing. Of these, there aro two principal types, one of which is an electrode made of finely ground titanium carbide, the other is composed of magnetite, chronium oxide, and rutile.

No production of molybdenum or uranium minerals and only a small output of tantalum mineral are known to have been made in the United States during 1909. The use of molybdenum in steel has not increased much. Tantalum incandescent electric lamps have such strong competition in tungsten lamps that the demand for tantalum minerals seems rather to have decreased than grown. The tantalum used in this country in 1909 was imported from Germany.

INDUSTRIAL POWER DATA.

The following table and curves are preliminary to a discussion on Industrial Power to be held at the February 24th meeting of the San Francisco Section of the American Institute of Electrical Engineers:

Motor Driven Machine Tools.

Motor driven machine tools, installed by Paul R. Shipley. Motors are all direct current, 220 volts. Motor ratings from name plates.

Tool.	Type.	Motor. H.P.	Amp.	R.P.M.
90 in. driving wheel lathe	Shunt	40	150	495- 950
90 in. driving wheel lathe, head	Comp.	½	28	950
72 in. driving wheel lathe	Interpole	10	42.5	400-1600
52 in. lathe	Interpole	7½	31.5	400-1600
36 in. lathe	Interpole	5	21.5	400-1600
30 in. lathe	Interpole	5	21.5	400-1600
18 in. brass lathe	Interpole	3¼	13.25	400-1600
Turret lathe	Shunt	3½	11.2	975
72 in. vertical boring mill	Interpole	7.2	31.2	400-1600
72 in. horizontal boring mill	Interpole	5	21.2	400-1600
51 in. vertical boring mill	Interpole	5	21.2	400-1600
78 in. radial drill	Shunt	5	19.2	1300-2000
48 in. planer	Comp.	15½	59.2	965
24 in. double head shaper	Comp.	6.5	25	870-1750
20 in. slotter	Interpole	10	42.2	400-1600
16 in. slotter	Interpole	5	21.2	400-1600
90 in. quartering machine	Shunt	3	11.2	1050-2000
90 in. wheel press	Comp.	10	39	780
60 in. punch and shears	Comp.	11.2	43	1125
36 in. punch and shears	Comp.	10	39	780
Horizontal punch and binder	Comp.	7½	28.5	975
Car wheel press	Comp.	10	39	780
D. H. axle lathe	Shunt	12	46	500-1000
Car wheel boring mill	Shunt	7	26.5	590-1180
Car wheel boring mill crane	Shunt	¾	3	700
60 in. x 20 ft. flue rattler	Comp.	25	90	725
42 in. planer	Shunt	15	56.5	875
42 in. planer head	Comp.	2	7.5	1200
Double head bolt threader	Interpole	5	21.2	400-1600
No. 9 Sturtevant fan	Comp.	17	59.5	1700
Bolt header	Comp.	13	49.5	875
Trip hammer	Comp.	10	39	780
Coach wheel lathe	Shunt	15	57.5	935
Iron bed wood planer	Comp.	10	38	935
Wood bed planer	Comp.	15.5	59	965
Triple valve grinder	Shunt	2	7.2	1100
70 ft. transfer table	Series	25	100	450
70 ft. turntable	Series	7½	30	750
50 ton coal hoist	Comp.	75	285	615-1120
Coach wheel lathe	Interpole	23	95	200- 600
Group drive—				
2 30 in. planers	Comp.	15	57	580
6 small lathes				
1 16 in. slotter				
1 60. in. radial drill press				
2 18 in. lathes				
1 36 in. emery wheel				
1 18 in. single head shaper	Comp.	10	39	760
3 turret lathes				
1 18 in. lathe				
1 small lathe				
1 milling machine				
1 36 in. emery wheel				
1 24 in. cut-off saw	Comp.	23	85	750
1 band saw				
1 mortising and food drilling machine.				
1 18 in. joiner				
1 rip saw				
1 bolt cutter				
2 small drill presses				
1 pipe cutting machine				
1 24 in. emery wheel				
1 48 in. grindstone				
1 18 in. cut-off saw	Comp.	23	85	750
2 rip saws				
1 mortising machine				
1 sticker				
1 wood shaper				
1 buffeting machine				
1 saw grinder				
1 grindstone				

100-Ton Crane—	H.P.	R.P.M.
3 240 amp series motors	55	50-500
1 72 amp. series motor	18	50-500
2 30 amp. series motors	7½	50-500

30-Ton Crane—	H.P.	R.P.M.
3 100 amp. series motors	25	575
2 13 amp. series motors	3.25	825

7½-Ton Crane—	H.P.	R.P.M.
1 30 amp. series motor	7½	750
1 44 amp. series motor	11	700
1 8 amp. series motor	2	900

Telephone Exchange Motors.

Curves, Fig. 1 and 2, form part of the standard specifications for motors used in the exchanges of the Pacific Telephone and Telegraph Company. The power factor and efficiency are in every case the minimum permissable for the particular horsepower and load specified.

Submitted by C. W. Burkett, Chief Engineer, P. T. & T. Co.

Test of Gold Dredger.

Figs. 3 and 4, submitted by Mr. L. E. Ettrop of the Marysville Dredging Company.

Motor Driven Geared Lathe.

Test of an induction motor direct connected to lathe through a series of gears. Cuts of different depths and feeds were taken at different surface speeds on a bar of soft steel. The tool was Bethlehem Special High Speed steel and Taylor pattern.

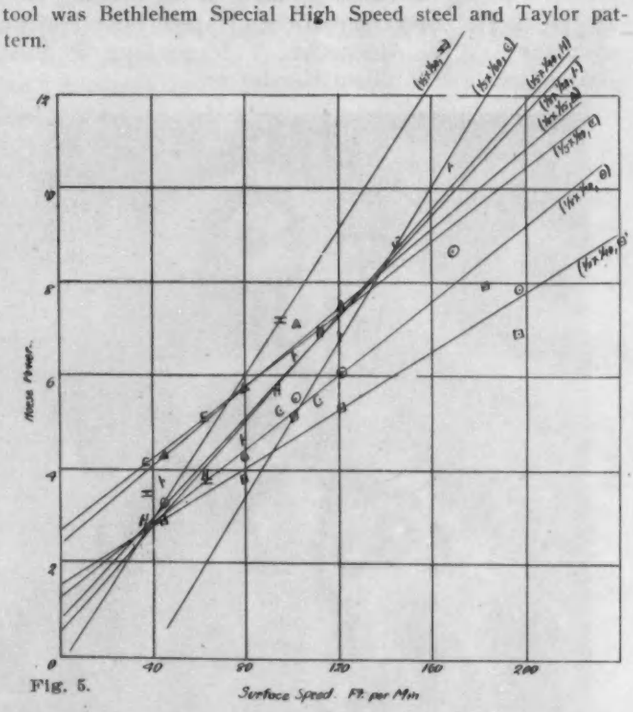


Fig. 5.

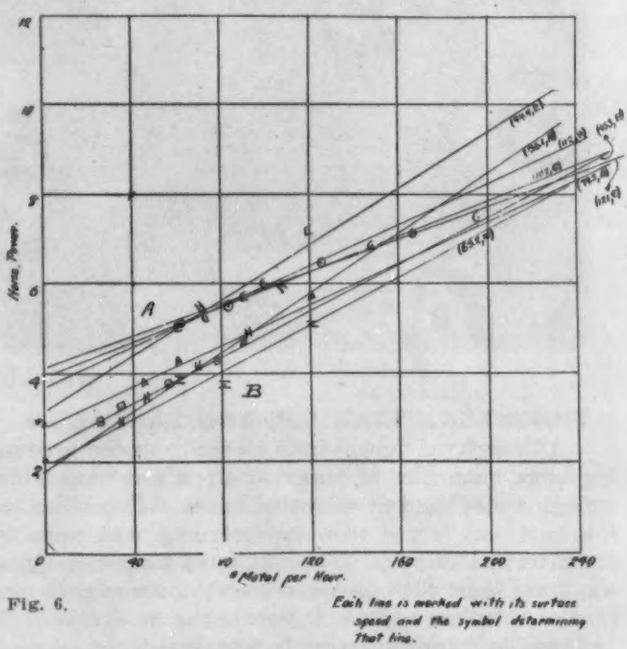


Fig. 6.

Each line is marked with its surface speed and the symbol determining that line.

Motor Data—Built by Westinghouse Electric & Mfg. Co.; type CCL. constant speed induction motor; 5 h.p., 200 volts, 12.3 amp. per terminal, 2-phase, 60 cycles, 1700 r.p.m. at full speed.

Lathe Data—Manufactured by Lodge & Shipley Machine Tool Co., Cincinnati, Ohio; style 18 in. patent head.

Figs. 5 and 6, submitted by H. H. Buell.

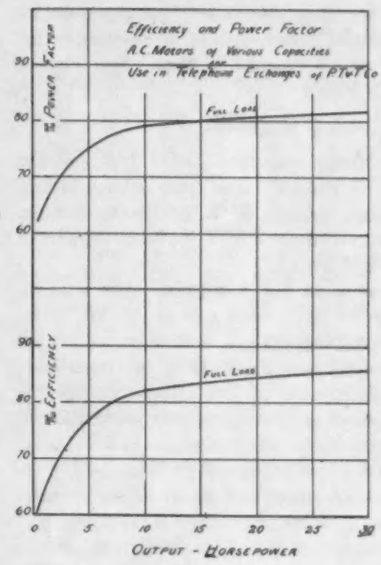


Fig. 1.

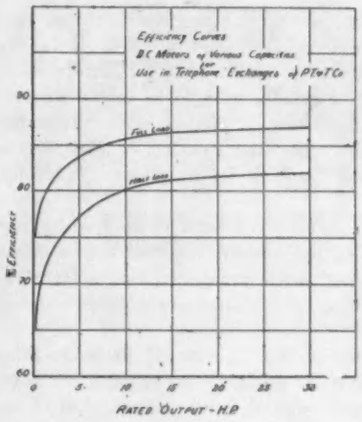


Fig. 2.

A.C. Motor Driven Centrifugal Pump.

An induction motor, two-phase squirrel-cage type was belted to a centrifugal pump. The pump discharged into a weir used to measure the quantity of water pumped. A Venturi meter was used to check this. The head, against which the pump was working, was varied by means of a valve; the first with the valve closed and maximum head, the second with the valve open and minimum head and the remaining three at points between the two.

The weir formula was $Q = 2.65\ H^{5/2}$; weir zero was .150; the barometer was 29.898; temperature of water, 60° F.

Apparatus Motor—General Electric Company induction motor; type 10-6-10A-1200; form K; h.p., 10; cycles, 60; speed, 1200; amperes, 23; volts, 200.

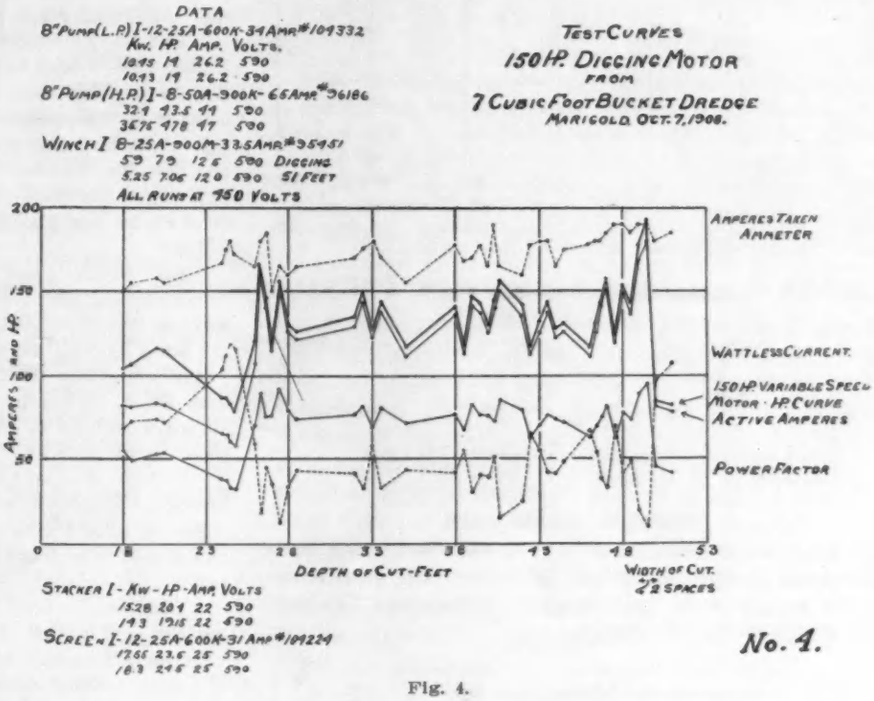

DATA
8" Pump (L.P.) I-12-25A-600K-34 Amp #104332
Kw. HP. Amp. Volts.
10.45 14 26.2 590
10.13 13 26.2 590
8" Pump (H.P.) I-8-50A-900K-65 Amp #96186
32.1 43.5 44 590
36.75 47.8 47 590
Winch I 8-25A-900M-33.5 Amp #95451
59 79 12.6 590 Digging
5.25 7.06 12.0 590 51 Feet
All Runs at 750 Volts
Test Curves
150 HP. Digging Motor
from
7 Cubic Foot Bucket Dredge
Marigold. Oct. 7, 1908.
Amperes and HP.
Amperes Taken Ammeter
Wattless Current.
150 HP. Variable Speed Motor - HP. Curve
Active Amperes
Power Factor
Depth of Cut-Feet
Width of Cut. 22 Spaces
Stacker I - Kw - HP - Amp. Volts
15.28 20.4 22 590
14.3 19.15 22 590
Screen I-12-25A-600K-31 Amp #104224
17.65 23.6 25 590
18.3 24.5 25 590
No. 4.

Fig. 4.

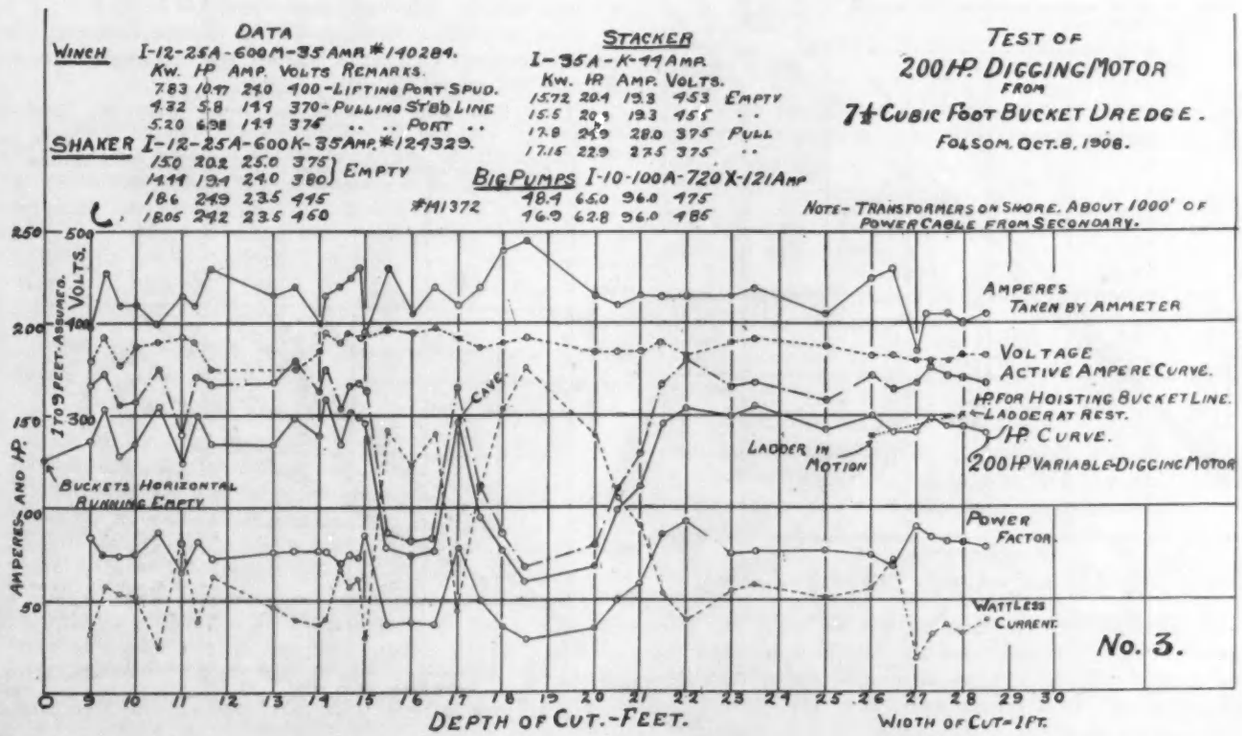


Fig. 3.

Pump.—Centrifugal type; diameter of runner, 7⅞ in.; diameter of discharge, 2 in.; diameter of suction, 2½ in.

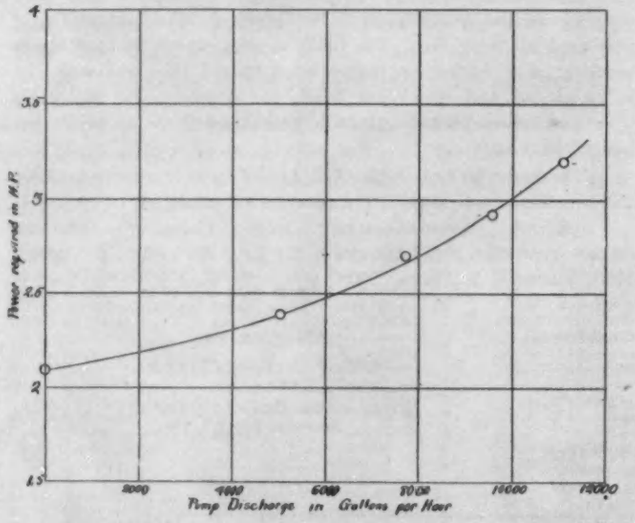


Fig. 7. 7⅞ in. Centrifugal Pump, 2 in. Discharge Diameter, 2½ in. Suction Diameter, 1700 r.p.m.

Combined Results—See Fig. 7.

Run.	gal. per hr. Pump dis.	Head.	H. P. Total	Pt.	in. of Hg. Suction
I	0	25	2.09	34.5	0
II	11,100	9	3.19	41.0	12.6
III	9,550	13	2.92	40.0	10
IV	7,700	17	2.70	38.2	6.5
V	5,000	21	2.39	36.1	3.5

Speed approximately constant at about 1700 r.p.m.
Submitted by H. H. Buell.

Test of 18 in. Reed Lathe.

This lathe is driven by a 2 h.p. direct current, shunt motor. The motor operates normally on 230 volts. The speed is controlled by varying the resistance in the field circuit. The motor was geared to the lathe spindle.

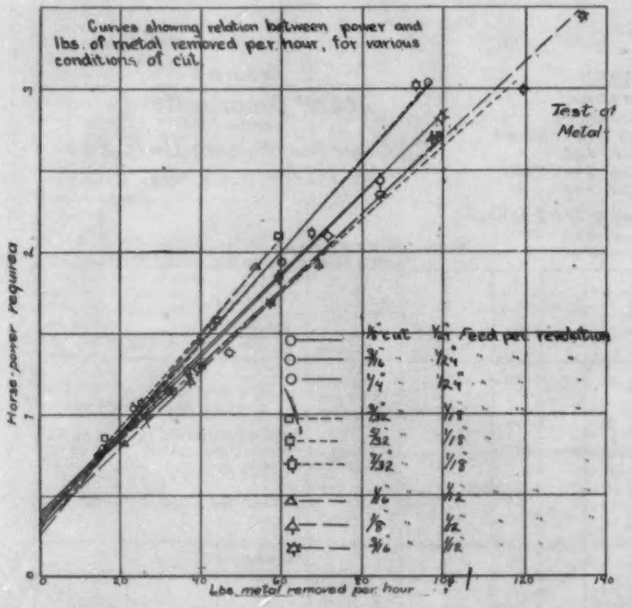

Curves showing relation between power and lbs. of metal removed per hour, for various conditions of cut.
Test of Metal
Horse-power required
Lbs. metal removed per hour
Feed per revolution

Fig. 8. Test of 18 in. Read Lathe Cutting Gray Cast Iron.

The piece of metal on which the test was made was a bar of gray cast iron. The head end was held in a three-jaw universal chuck. The tool used was made of Bethlehem high speed steel, and was a Taylor pattern tool.

From the curves we see that the power required varies directly as the amount of metal removed and is practically independent of the depth of cut on amount of feed. See Figs. 8 and 9. Submitted by W. C. North.

Wood-Working Machines.

Load on Test No. 1.—Motor with 64 ft. of 2 7/16 in. line shaft running in 9 standard hangers with ring oiling boxes, together with 161 ft. of single belting, 62 ft. of double belting, 7 loose pulleys and a 1⅜ countershaft 2 ft. 8 in. long, supported by oil boxes. Power input 2.84 kw.

Test No. 2.—Load the same as No. 1, together with a 24 in. J. A. Fay single belt driven surfacer, on 2 x 24 in. R. W. ⅛ in. deep cut at 16 ft. min., and 6 loose pulleys, 6 ft. 8 in. of 1⅝ in. counter shaft, supported in 4 oil boxes and 20 ft. of single belting. Additional power input 5.59 kw.

Test No. 3.—Load the same as No. 1, together with a 24 in. Valley City, 2-belt driven surfacer on 2 x 24 in. R. W. ⅛ in. deep cut at 32 ft. min., and 6 loose pulleys, 7 ft. 6 in. of 1⅝ in. counter shaft supported in 4 oil boxes and 20 ft. of single belting. Additional power input 5.84 kw.

Test No. 4.—Load the same as No. 1, together with 65 ft. of 2 15/16 line shaft running in 9 standard oil boxes and 301 ft. of 2½ in. single belting on 14 loose pulleys. Additional power 2.71 kw.

Test No. 5.—Load same as No. 1, together with all machines running idle; two single surfacers, 24 in. blade; 1 variety wood-worker, 9 in. blade; 10 speed lathes, 14 in.; 1 pattern maker's lathe, 20 in.; 1 mortiser; 1 grinder of 4, 12 in. emery wheels; 1 grindstone, 3 ft. dia.; 1 band saw; 1 circular saw. Together with 176 ft. of 1⅝ in. counter shafting running in 28 standard oil boxes and 244 ft. of single belting 2½ in. wide. Additional power input, 10.13 kw.

Test No. 6.—Load same as in No. 1, with 14 in. circular saw cutting on 2 in. O. P. at 7 ft. per minute, together with 6 loose pulleys, 6 ft. of 1⅝ in. counter shafting supported on 4 oil bearings and 12 ft. of single belting. Additional power input 1.02 kw. avg.

Test No. 7.—Load same as No. 1, with ¾ in. wide band saw cutting 2 in. O.P. at 24 ft. per minute (saw running on 36 in. wheel at 375 r.p.m.), together with 6 loose pulleys, 2 ft. 8 in. of 1⅝ in. counter shafting supported in 2 oil boxes and 14 ft. of single belting. Additional power input 1.84 kw.

Data on Motor.—Made by General Electric Company, two-phase induction, 25 h.p., class 8-20-900, type I Q., form L, cycles 60, volts 220, special No. 1895.

These tests were made in the wood shop of Stanford

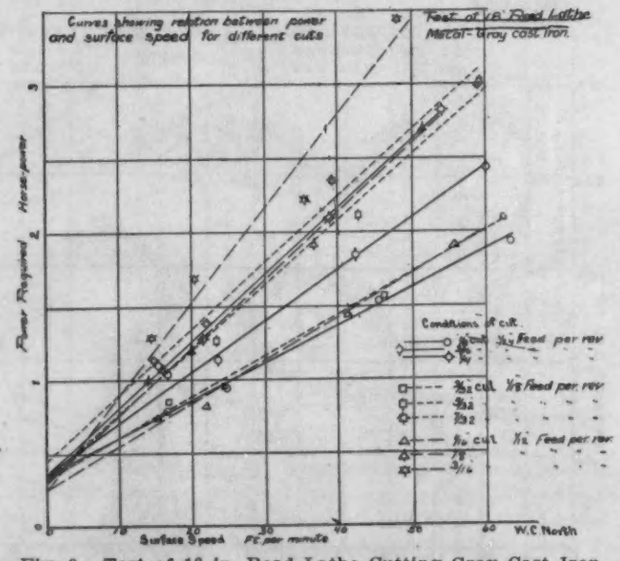

Curves showing relation between power and surface speed for different cuts
Test of 18" Reed Lathe
Metal= Gray cast Iron.
Power Required Horse-power
Surface Speed Ft. per minute
W.C. North

Fig. 9. Test of 18 in. Read Lathe Cutting Gray Cast Iron.

University, April 7, 1909, by C. L. Bradley, A. C. Coonradt, H. L. Hess, C. N. Hoskinson.

PHASE A			PHASE B							
Wattmeter.	Ammeter.	Voltmeter.	Wattmeter.	Ammeter.	Voltmeter.	Motor r.p.m.	Blast gage inches of water.	Exhaust gage inches of water.	Number of forges in operation.	Total power in kw.
7.01	35.25	225	6.57	32.	223	1190	7.2	2.70	8	13.58
7.66	36.0	228	7.44	34.5	229	1170	7.1	2.30	16	15.10
7.88	37.0	231	7.66	35.25	225	1155	7.0	2.10	24	15.54

Pressure Blower.

Test of a No. 7 Buffalo Forge Company's pressure blower and a 60 in. exhaust fan, manufactured by the same firm, supplying 24 standard 3 in. tuyer Buffalo forges.

Ducts are of sewer pipe. Main ducts, blast 14 in. dia.; main ducts, exhaust 24 in. dia.; most distant forge is 72 ft. from fans.

The most interesting thing in connection with this test is the fact that it takes practically no more power to supply the 24 forges than it does when only 16 are on.

Motor Data—Two-phase, 69 cycle, 20 h.p., 220 volt, 1200 r.p.m. Submitted by W. C. Cole.

Test of Exhaust Fan for Foundry.

No. 5 Buffalo draught fan furnishing the required draught for a 26 in. cupola, through a 10 in. pipe, 26 ft. long, with three right angled bends in it, to 6 tuyers 4 x 6 in.

Length of time blast was on, 38 min.; iron melted, 1700 lb.; length of time before iron appeared after turning on the blast, 10 min.; amount of iron drawn off each time cupola was tapped, about 400 lb; number of times cupola was tapped, 5.

Motor Data.—10 h.p., two-phase, 60 cycle, 220 volt, 1200 r.p.m.

The motor was belted to a line shaft 16 ft. long, mounted on three floor brackets. The fan was belted to line shaft. No load run was made with only line shaft belted to motor.

Test Data—

Time.	Total Power, KW.	Pressure
2:20	8.2	7
2:30	8.3	7
2:40	8.0	
2:50	7.45	6
2:53	7.6	5½
No load	1.26	

Submitted by W. C. Cole.

Test of Motor Driven Hacksaw.

Two-phase, 60 cycle, 220 volt induction motor. Saw—Length of stroke, 6 in.; number of complete strokes per min., about 60.

Volts per phase.	Current per phase.	Power, total, watts,	Power factor.	
238.9	.80	111.6	.29	No load
242.8	.825	149.6	.38	1½ in. cut in steel
239.5	.82	136.4	.35	2 in. cut in cast iron

Submitted 3-6, 1909, by A. J. Gowan, F. J. Hettman, A. B. Cox.

Power Used by L. S. J. U. Machine Shop.

Power for shop tested is furnished by a 20 h.p., two-phase 60 cycle, 220 volt, 900 r.p.m. induction motor.

Measurements of the power required to drive the motor under the following loads were made:

A—Motor driving clutch pulley which ran loose on main shaft, 50 ft. of 8 in. belting, two ply.

B—Motor driving clutch pulley, clutch in, and 64 ft. of 2 7/16 in. shafting running in 11 hangers with oil boxes. All belts were off except the one connecting motor to clutch pulley as tested in A.

C—Load same as in B with the addition of 510 ft. of belting and 23 loose pulleys on countershafts.

D—Load same as B, together with 927 ft. of belting and the following machines running light.

Machines: Lathes—1 Jones & Samson turrett, 12 by 24 in; 1 20 in. lathe; 1 16 in. lathe, 2 14 in. lathes, 1 12 in. lathe; 1 Brown & Sharpe No. 3 cutter and reimer grinder, 1 Brown & Sharpe No. 1 universal grinder, 1 Cincinnati Milling Machine Co. No. 1½ milling machine, 1 12 in. emery wheel and buffer, 1 24 in. emery wheel, 2 14 in. emery wheels (same shaft), 1 24x72 in. planer, 1 16 in. crank shaper, 1 3 in. centering machine, 1 36 in. grindstone, 1 W. S. & J. Barnes Co. No. O friction drill press, 1 W. S. & J. Barnes Co. 26 in. drill press.

Results of Tests.

Part.	Power, KW.	Average Pf.	Output H.P. Power.	Input H.P. Power.
*A	2.45	.221	.75	3.29
*B	2.20	.206	.50	2.95
C	3.24	.247	1.88	4.35
D	6.17	.480	5.55	8.28

*As shown by these results the friction of clutch pulley is greater than friction of shaft. The difference however is not great enough to start shaft from rest with clutch out, but will keep shafting running after it is started if the clutch is pulled out.

The h.p. output were found by means of an efficiency curve computed from the circle diagram for the motor.

Submitted by J. D. Taggart, H. M. Haver, E. P, Tallant.

WASHINGTON WATER POWER CO. REPORT.

Extensions and betterments contemplated for 1911 by the Washington Water Power Company are outlined in an exhaustive report submitted by D. L. Huntington, president, at the annual meeting of stockholders at Spokane, Wash., on February 6. The annual report shows that during the year the company relaid with 70-pound steel rails and paved between rails 11.09 miles of track, double-tracked 1.56 miles of road and extended lines 7.9 miles. They added 10 passenger cars and one work car and equipped the interurban railway lines with an automatic block signal system of the most modern and efficient type. Statistics covering the street railway system show:

	1909.	1910.
Miles of street occupied	45.26	48.79
Miles of track	100.96	108.92
Passengers carried	21,842,767	24,730,145
Car miles run	3,624,586	3,990,653
Car hours run	435,541	465,516

The foregoing statistics cover the whole system excepting passengers carried and streets occupied. which are for city lines only.

The comparative statement of the company for the years ended December 31, 1909, and December 31, 1910, is as follows:

	1909.	1910.
Outstanding stocks	$7,223,200	$9,390,100
Outstanding bonds	5,547,000	5,838,000
Notes and other debts	25,000	775,000
Gross earnings	2,788,742	3,155,223
Annual allowance for depreciation	273,600	314,400
Net earnings for stock	675,036	918,773
Surplus to date	860,499	1,071,041

A regular dividend of 7 per cent was paid in 1910 and an extra dividend of 1 per cent was paid January 3, 1911. A quarterly dividend of 2 per cent has been declared payable April 1 to stockholders of record March 15.

The power station at Little Falls was put in operation July 29, 1910. There are now installed there three generating units of 5000 kilowatts rated capacity, and the fourth unit will be placed in operation by midsummer of 1911. The storage battery station of the company was nearly completed at the close of the year and will be in operation early in 1911.

During the year 226,632 duct-feet of underground conduits were installed in the business district.

The company has purchased the lighting and power distributing system and business in the town of Colfax, Wash., and it is now operated directly by the company. The service has been improved, the street lighting entirely changed, and public sentiment shows decided appreciation of the new ownership.

An extension of the high tension transmission lines, has been made to Odessa, and a local distributing system has been installed and is being operated by the company, with results satisfactory to the residents and to the company. The desire of the residents of these towns for the direct ownership and operation of the local lighting plants by a large and responsible company, instead of through leases of power to local owners, is an interesting and important sign of the times.

The greatest undertaking of the year has been the acquiring of new water rights on the Spokane River at a point four miles above Little Falls, and the commencement of construction there of the largest of the company's power stations, to be known as Long Lake stations. The development contemplates the erection of a solid concrete dam giving a fall of 170 feet and forming a lake about 23 miles in length and nearly three-eights of a mile in average width. An interesting form of movable roller dam, considerably used in Europe, but not heretofore adopted in the United States, will be used for the purpose of discharging flood water and regulating the water level of the lake.

The installation will consist ultimately of four generating units of 12,500 kilowatts (16,666 electric horsepower) each, connected to turbine water-wheels, with a capacity of 22,500 horsepower each. These water-wheels will exceed in size and capacity any other now in existence. Two such units will be installed at first, and the others will be added as required. It is hoped to have this plant in operation by the fall of 1912. The plant when completed will more than double the hydraulic power capacity of the company.

During 1910 the outstanding capital stock of the company was increased April 1 by the issue of 30 per cent at par, from $7,225,200 to $9,390,000, and a further issue of 25 per cent was taken January 3, 1911, making the total amount now outstanding $11,737,600. In anticipation of the stock issue of January 3, 1911, the company borrowed in all $775,000 toward the end of the year, which was paid off January 3.

ELECTRICITY IN RURAL DISTRICTS.

Data is now being collected by a special committee of the National Electric Light Association from which to prepare a report on the use of electricity in rural districts. This committee, whose Pacific Coast member is S. M. Kennedy, general agent of the Southern California Edison Electric Co., Los Angeles, requests information on this subject from every company and individual knowing of any novel or special use to which electricity is being applied on the farm. Engineering details are unnecessary, merely a photograph and brief description.

CALIFORNIA PUBLIC SERVICE COMMISSION BILLS.

In response to a number of requests a summary of Senate Bill No. 464 and Assembly Bill No. 671 is here presented.

These bills create a commission to be composed of three members to be appointed by the Governor for four-year terms at an annual salary of $8000 each. The commissioners are to devote their time exclusively to the work of their commission and are prohibited from holding any stock or bonds or to hold official relations with corporations subject to their supervision. One commissioner must be a lawyer and one other "a man familiar with or having knowledge of one or more branches of the public service business."

The commissioners have power to appoint counsel at a $5000 salary, a secretary at $4200 salary and all necessary employes.

Offices are to be maintained in San Francisco and stated meetings are to be held at least once a month, all sessions and all records being open to the public. Annual reports are to be issued containing a copy of all orders and determinations.

The commission shall have power to inquire into and investigate all public service business except railroads, having the supervision of the manner in which they are conducted, to prescribe the form of reports and uniform methods of accounting. They shall also determine reasonable rates for service from both private and municipal plants and prescribe adequate safety devices, companies affected paying all costs of investigation.

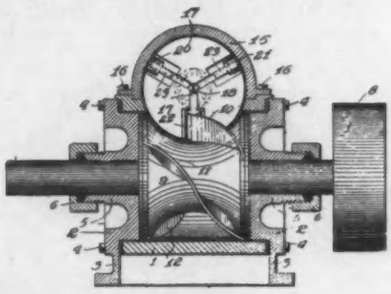
Furthermore they shall have full power "to examine and inquire into all issues of stocks, bonds and other evidences of indebtedness, * * and to publish the facts concerning the same," to issue or deny permits for making expenditures and sales or leases. They may order necessary repairs, additions, changes or improvements, inspect all equipment and all company records, make valuations, fix service standards and issue permits and licenses.

All rates, tolls, charges and schedules fixed by the commission shall be in force until otherwise found by a competent court of jurisdiction. Fines of from $100 to $1000 as provided for non-compliance with the commission's orders. This act includes in its provisions the business done by "railroad companies, street railway companies, ferry companies and express companies in the transmission or transportation of passengers, freight or express, and by telephone and telegraph companies in the transmission or conveyance of telephone or telegraph messages, and by pipe line companies in the transmission, for others, of oil or other fluids by pipe line, and by light, heat, water or power companies in the supplying, delivering or furnishing of light, heat, water or power."

Senate Bill No. 465 and Assembly Bill No. 672 provides for an amendment to the Civil Code to be ratified by the voters of the State in order that this public service commission law be thus legalized.

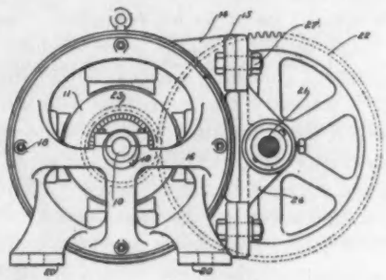
PATENTS

983,365. Pump. Byron W. Haskell, Oakland, Cal. In a pump of the character described, a cylinder, a rotary piston having spiral blades, and a rotary disk projecting into said



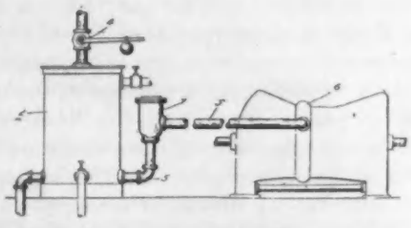
cylinder bearing against said piston and having openings with movable covers adapted to be engaged in by said spiral blades, said rotary disk being located between the inlet and outlet ports of the cylinder.

983,361. Back-Geared Motor. Alexander M. Gray, Milwaukee, Wis., assignor to Allis-Chalmers Company. In a dynamo-electric machine, a main shaft, a frame comprising a field yoke and end heads which have supporting portions and



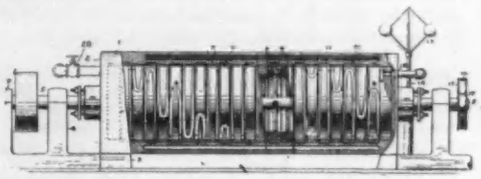
which are secured to the yoke and support the main shaft, and a counter shaft supported on the yoke, said end heads being stationary and said yoke being adjustable relatively thereto.

983,282. Feed-water Heater. Francis Hodgkinson, Edgewood Park, Pa., assignor to the Westinghouse Machine Company. The combination with a feed-water heater and its



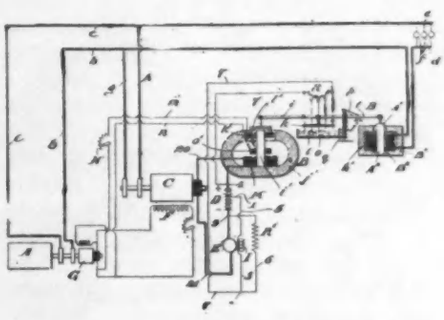
supply pipe, of a turbine adapted to receive and utilize steam from said heater and means for controlling the fluid pressure in said heater and for delivering fluid therefrom to said turbine.

983,653. Turbine. Byron Stevens, Oakland, Cal. In a steam turbine, the combination of a shaft, wheels secured on said shaft, a casing for the turbine, disks secured to the casing and alternating with the wheels, the peripheries of the disks and wheels being formed with ports and passages respectively, each port and passage leading from one side of the disk or wheel to the other, each port and passage having its inlet and outlet portions extending in nearly opposite direc-



tions, each port and passage being open at its side to the adjacent wheel or disk, the inlet portions of the ports and passages, and also the outlet portions thereof, opening in opposite directions, the outlet portions of the passages being of sufficiently greater sectional area than of the inlet portions thereof to cause the pressure fluid flowing through the passages to flow into the outlet portions of the passage with a velocity greater than in the inner portions thereof by slightly more than twice the velocity of the periphery of the wheels, substantially as described.

983,670. Alternating-Current System of Distribution, Regulation and Control. Joseph Bijur, New York, N. Y., assignor by mesne assignments, to The Electric Storage Battery Company, Philadelphia. The combination of an alternating current source of supply, an alternating current work circuit, a storage battery to compensate for variations in the load, regulating means responsive to both the variations in the work



circuit and the direction and amount of current of the storage battery, and operated by variations in the work circuit, said regulating means starting to operate when the load on the work circuit varies from the average and continuing to operate until the energy given out by the battery or absorbed thereby compensates for the increase or decrease of energy demanded by the work circuit.

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POWER AND GAS

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Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July 1895.
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Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

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Electrical Legislation

As most electrical work is known to be dangerous, employers have usually provided every reasonable protection for those engaged therein. Expense has not hindered the installation of any safety appliance or protective device likely to reduce the life hazard of electricity. Statistics show, however, that a large proportion of the unfortunate accidents among electrical workers may be traced to the carelessness of men who know better, but who have become contemptuous of the danger involved. For such neglect in observing ordinary care no adequate protection can be offered.

Notwithstanding the fact that electric companies have voluntarily done their utmost to minimize the number of accidents, three bills have been introduced at the present session of the California legislature to compel the companies to reconstruct practically every pole line in the State. Ostensibly these bills are meant to lessen the danger associated with the lineman's occupation, but in reality they are said to be intended to provide more work for these men.

The most radical requirements of the bills are a twenty-six-inch spacing between all overhead conductors and an insulated or grounded guard-wire beneath all high-tension circuits of 15,000 volts or more. While there is some recent construction where wires have been thus strung, there are thousands of miles of line which would have to be rebuilt in order to comply with these rulings. The most absurd suggestion is that no street manhole be placed within three feet of an electric railway track, so that the workmen may not be injured by a passing car. That this spacing is almost physically impossible is indicated by the fact that there are corners in San Francisco where as many as forty-six manholes are in use.

The bills have met with great opposition, not so much on account of their requirements for new work as because of their retroactive effect on all old work. They propose an immediate revolution instead of a gradual evolution whereby changes could be made in the ordinary course of reconstruction. Furthermore, if the proposed public service commission is established the commissioners will have full power to order any changes that are necessary to protect life or property, and these new laws would be unnecessary.

As there is far greater likelihood that the public service commission act will be passed than that these special electrical laws will be enacted, we would suggest that their sponsors might well lend their support to the broader measure with the assurance that an impartial board of public service commissioners will give careful attention to protecting the lives not only of electrical workers, but also of the general public. However, even should these bills pass the legislature, they contain a number of illegal provisions which would soon nullify all others when the matter was passed upon by the courts. Their enforcement means the ruination of all farmers' telephone lines and many small companies, as well as the serious embarrassment of the larger ones. How this can permanently help the electrical worker we fail to see.

PERSONALS.

S. K. Colby, vice-president of Pierson, Roeding & Co., is in the Pacific Northwest.

F. A. Cressey, manager of the Modesto Electric Company, visited San Francisco this week.

L. F. Wyman has been appointed electrical engineer of the Loyal Railway at Ballard, Wash.

R. G. Arthur has been made general manager of the Douglas Street Railway at Douglas, Ariz.

C. R. Downs, who is interested in a lighting company at Sutter Creek, recently arrived at San Francisco.

Dr. E. S. O'Brien, who has electric lighting interests at Merced, was a San Francisco visitor during the past week.

R. S. Chapman, an engineer interested in hydroelectric developments, has arrived at San Francisco from Portland.

R. L. Noggle has been appointed superintendent of the Northern Idaho and Montana Power Co. at Sand Point, Idaho.

C. F. Flinn, of the Allis-Chalmers Company's sales force, has returned to the San Francisco office after a Northern California tour.

A. C. Sprout went to Stockton last Tuesday on business connected with electric pumping in the San Joaquin reclamation districts.

K. T. Roebling, of the wire manufacturing firm of John Roebling & Sons of Trenton, N. J., is visiting their San Francisco branch house.

N. M. Fruehauf has succeeded Chas. E. Watkinson as acting auditor of the San Francisco, Vallejo and Napa Valley Railroad, Napa, Cal.

Ray Fulcher, construction engineer with Sanderson & Porter, is inspecting the Relief Creek dam of the Sierra & San Francisco Power Co.

T. D. Petch, manager of the Santa Rosa district of the Pacific Gas & Electric Company, has resigned and will be succeeded by M. G. Hall.

Frank H. Varney, engineer of operation in the Pacific Gas & Electric Company's steam plant department, left last week for a month's Eastern trip.

C. F. Pearson, general superintendent of the Southern California Edison Electric Company of Los Angeles has been spending several days at Sacramento.

H. E. Adams, the Stockton manager of the Western States Gas & Electric Co., an H. M. Byllesby & Co., interest, has moved into elegant new offices on the corner of Weber and Sutter streets.

E. G. Dewald, of the Pelton Water Wheel Company selling corps, is at Tacoma in connection with the bidding on the new municipal hydroelectric plant known as the Nisqually River development.

L. S. Twomey has been appointed Pacific Coast representative of the engineering department of the National Electric Lamp Association with headquarters at 1648 Sixteenth street, Oakland, Cal.

M. S. Hopkins, of the Clark syndicate, which now controls the Portland Railway, Light and Power Company, as well as electric plants in St. Louis and Eastern cities, is visiting Portland, Ore., from Cleveland on an inspection tour.

R. H. Sperling, general manager of the British Columbia Electric Railway Company, has arrived at San Francisco from Vancouver. He will also tour Southern California while reviewing the latest developments in electric railway transportation and power work.

E. N. Sanderson, of the firm of Sanderson & Porter, has left for the East via Los Angeles and Albuquerque, N. M. He has been inspecting the company's various plants throughout the Pacific Coast.

F. F. Barbour has resigned as assistant to the president of the Portland Railway, Light & Power Company and on March 1 he will become assistant to the president of the Pacific Gas & Electric Company at San Francisco. He was for a number of years at the head of the sales department in the General Electric Company's San Francisco office.

M. C. McKay, superintendent of the Sierra & San Francisco Power Company's Stanislaus Division is at the San Francisco office from his headquarters at the Stanislaus hydroelectric plant near Vallecito. There have been no interruptions to the service from weather conditions this winter, notwithstanding the unusually heavy snowfall in the mountains.

Newly elected associate members of the American Institute of Electrical Engineers include E. S. Code, engineer Westinghouse Electric & Mfg. Co., Seattle, Wash.; Chas. L. Easton, superintendent of power, San Joaquin Light & Power Co., North Fork, Cal.; Austin B. Gates, Alhambra, Cal.; H. B. Hatfield, city foreman underground department, San Francisco Gas & Electric Co., San Francisco, Cal.; G. L. Hedges, designer Kelman Electric & Mfg. Co., Los Angeles, Cal.; M. R Lott, electrical engineer Telluride Power Co., Provo, Utah; P. D. Naugle, electrical machinist, and Richard Nightingale, draughtsman at Puget Sound Navy Yard, Bremerton, Wash.; Roy Page, draughtsman Southern Pacific Co., San Francisco, Cal.; J. T. Percival, Jr., electrical draughtsman, Washington Water Power Co., Spokane, Wash; L. W. Roush, secretary and engineer Gunnison Valley Power Co., Gunnison, Utah; J. A. Runchey, superintendent power house, Washington Water Power Co., Reardon, Wash.; H. A. Seabright, electrical engineer, Idaho Electric Supply Co., Boise, Idaho; W. P. Shippee, superintendent of power, U. S. Reclamation Service, Spanish Fork, Utah; Frank S. Warren, construction department, Pacific Gas & Electric Co., San Francisco, Cal.; E. A. West, Jr., assistant engineer, Portland Railway, Light & Power Co., Portland, Ore.

PACIFIC COAST A. I. E. E. MEETING.

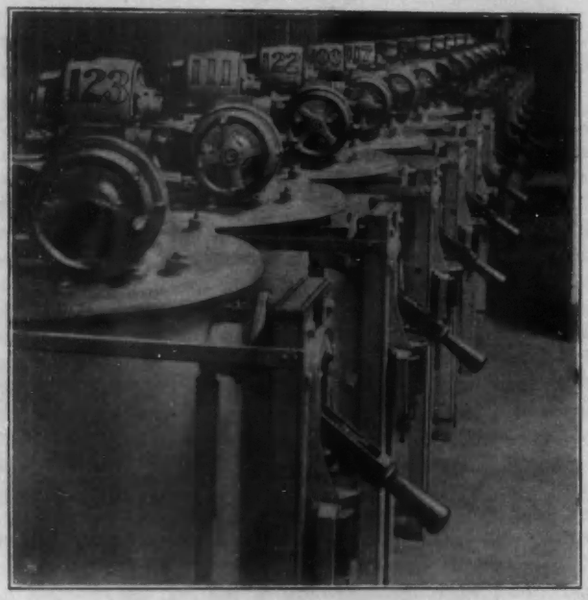
Preparations for the Pacific Coast meeting of the American Institute of Electrical Engineers at Los Angeles, Cal., on April 25, 26, 27 and 28, 1911, are now being made by the local committee appointed by President Jackson, consisting of the following members and associates: Los Angeles Section—J. E. Macdonald, chairman; S. H. Anderson, V. L. Benedict, I. T. Dyer, O. H. Ensign, J. A. Lighthipe, E. F. Scattergood. Associate members of the committee—A. H. Babcock, San Francisco, Cal.; S. G. McMeen, San Francisco, Cal.; C. L. Cory, Berkeley, Cal.; H. J. Ryan, Stanford University, Cal.; L. B. Cramer, Portland, Oregon; A. A. Miller, Seattle, Wash.; J. B. Fisken, Spokane, Wash.

Important papers will be presented under the auspices of the high tension transmission, railway, and telegraphy and telephony committees, which are expected to give valuable information regarding Pacific Coast practice in various developments. All members who contemplate a trip to California will find this a desirable opportunity as the local electrical companies are co-operating with the committee to promote every facility for the information and entertainment of visitors. The program will include trips to Edison plants and excursions to Santa Ana Canyon, Mount Lowe, and probably Catalina Island. Additional details will be published later, but inquiries will receive attention if addressed to V. L. Benedict, Local Secretary, Los Angeles Fire Alarm Company, Los Angeles, Cal.

INDUSTRIAL

A LARGE EQUIPMENT OF FEEDER REGULATORS.

Where an alternating current central station is in competition with a direct current plant in a large city, conditions are often unfavorable to the alternating current proposition. The chief disadvantage arises from the sensitiveness of the voltage regulation to any changes in load. Where a large part of the load is made up of elevators or other machinery requiring frequent starting, an alternating current



Automatic Feeder Regulators.

line is apt to suffer considerably more from fluctuations in voltage than is an equivalent direct current. The direct current system suffers only from line drop, while the alternating current line has the line drop of resistance and reactance and in addition an actual reduction of voltage at the generators or transformers due to the wattless current at the low power factor of starting. A load that would produce a fluctuation in a direct current line of two or three per cent might under some conditions cause as much as twenty per cent fluctuation in an alternating current line. In such cases the use of feeder regulators remove entirely this disadvantage of the alternating current system and in many cases gives even better regulation than is obtainable with a direct current system.

A case in point is that of the United Electric Light & Power Company of New York. The 146th Street sub-station of this company supplies a load made up largely of apartment house equipments, consisting mostly of lights and elevators. The voltage fluctuation on the feeders due to the starting of elevators, put such a heavy drawback on the service as to make competition with the direct current systems in the city, equipped with storage batteries and other equalizing devices, almost impossible. Equipping the system with feeder regulators, however, has not only resulted in marked benefits but has made the service preferable to that of the direct current system.

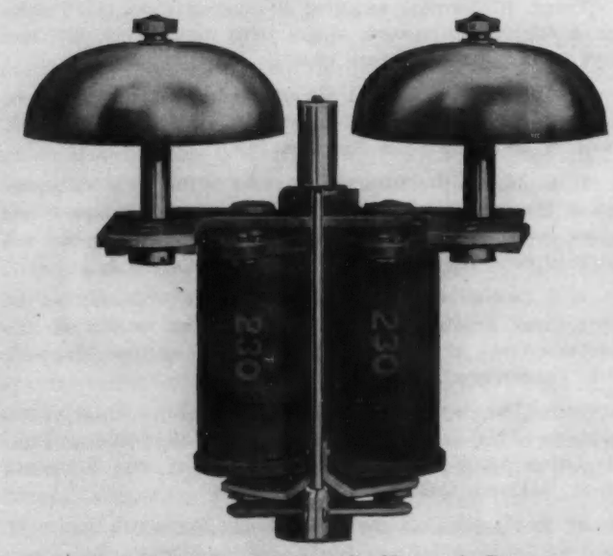
The regulator equipment consists of 20 two-phase automatic induction type feeder regulators, manufactured by the Westinghouse Electric & Manufacturing Company, Pittsburg. Each regulator is of 85 kva. capacity and has a range of regulation of 10 per cent above or below the busbar voltage. Each regulator is operated by a 220 volt 4/10 h.p. Westinghouse direct current motor controlled by regulating relays. The relays operate through voltmeter compensators so as to maintain constant voltage at the service end of the feeders. Each feeder has a complete equipment of compensator, relays and regulators.

The results obtained are in some ways remarkable. So sensitive are the relays that the voltage at the service point at no time varies more than one per cent. The automatic operation is practically instantaneous, and lights, even in the same building with the elevator that is started, barely show a flicker. The voltage at the station end of the feeder, however, varies as much as 15 per cent showing the part played by the regulators in smoothing out the voltage curve.

The accompanying illustration shows a photograph of 14 of these regulators in operation. The regulators are of the standard induction type manufactured by the Westinghouse Company. The regulation depends on the angular position of a rotatable secondary core and winding relative to a stationary primary core and winding, the two windings being connected in series. Rotation of the secondary is produced by the small motor at the top of each case, controlled by the relays. The adjustment of voltage is gradual, which corresponds to practically an infinite number of steps. Each regulator is self-contained and cooled by air blast, with which the station is amply supplied for cooling its transformers.

A NEW HARMONIC RINGER.

The Western Electric Company has recently placed on the market a new harmonic ringer, which has proven from actual service that it will satisfactorily meet the most exacting conditions.



No. 41 Type Western Electric Harmonic Ringer.

This ringer, known as the No. 41 type, operates on the same potential of 140 volts for all four frequencies. This simplifies the harmonic ringing system and eliminates the use of the higher voltages, which have been objectionable in low voltage telephone circuits and apparatus.

The construction of this ringer is such that no armature adjustment is required after it leaves the factory. The

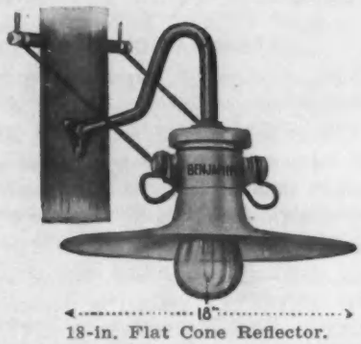
adjustment of the gongs can be quickly, easily and accurately made by means of an eccentric screw. After the adjustment is once made the gongs can be rigidly and permanently set by tightening the screws which lie directly behind the adjusting screw. The very simplicity of the adjustment of this ringer is a unique feature, as the only tool required is an ordinary screw-driver, which every repair man carries in his pocket.

The coils of this ringer are wound with black enameled wire, which makes them practically impervious to moisture. This enamel insulation will stand a temperature that would destroy the usual silk and cotton insulation. Because of the decrease in the overall diameter of the wire, due to the use of enamel insulation, the ringer coils can be wound to a much higher efficiency.

Every detail in this ringer has been especially designed for strength, durability and ease of adjustment with a view of practically eliminating the factor of ringer maintenance in Harmonic Systems.

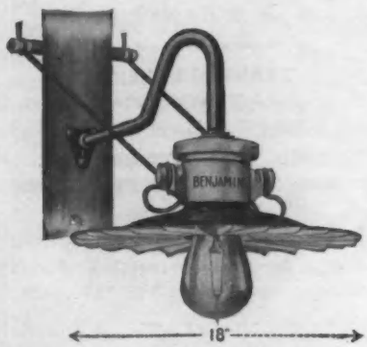
BENJAMIN HIGH VOLTAGE STREET SERIES (FILM CUT-OUT) LIGHTING UNITS.

The Benjamin Electric Manufacturing Company is attracting attention by a number of new street series lighting fixtures which they are placing upon the market. Representative cuts of both fixtures and sockets are shown with the accompanying descriptive matter.



18-in. Flat Cone Reflector.

The socket consists of essentially three porcelain parts: (1) A central or body portion with integrally formed knobs; (2) A lower removable bushing carrying the threaded socket shell and film cut-out spring; (3) A surmounting petticoat insulator.



18-in. Radial Wave Reflector.

The base portion has a center bore in which are located the center spring and short-circuiting contact, together with means for co-operating with the lower or removable portion. Beneath the knob are grooves forming protected and insulated passages for the wires. On the upper side of the base there is an iron fitting supported by four screws deeply counter-sunk in porcelain. Between the two is a rubber disc. The lower part may be inserted by merely pushing it forward and turning to the right, or removed by pulling it outward and turning to the left. It cannot become disconnected by turning the lamp. The petticoat insulator is held in position by a lock nut and washers passing over the upper end of the fitting, thus making a water-tight joint. The device is thus a combined

18-in. Flat Cone Reflector and Globe.

socket, cross arm and insulator, with three distinctive features: (1) Compactness; (2) strength; (3) high insulation. It is supplied for span wire suspension, or with fitting adapted for gooseneck or other ¾ in. pipe connections. The reflectors used are thoroughly insulated from the support. They are attached by means of four screws passing through holes cemented in the back. Cat. No. 1521 shows an 18 in. flat cone reflector; Cat. No. 1491 an 18 in. radial wave reflector; Cat. No. 1581, an 18 in. flat cone reflector incorporating a globe holder, and an 8 in. by 6½ in. glass globe. Prices and discounts, together with further descriptive information, may be secured by addressing the company's office at 151 New Montgomery street, San Francisco, Cal.

THE ROUND TABLERS.

Mr. A. N. Fox, manager publicity department of the Benjamin Mfg. Co., Chicago, has been elected chairman of the "Round Tablers," a newly organized group of advertising men who meet once a week in the rooms of the Chicago Advertising Association for the purpose of a systematic study of the various phases of trade publicity.

Fearless and wide open discussion is the slogan of the organization. After an address by an invited speaker the meeting is thrown open to those present, and the subject under discussion analyzed with particular regard for securing definite, concrete, and practical results. During December the following topics were taken up: "Large Space In Advertising," R. R. Shuman; "Style In Advertising," A. B. Jensen; "Cultivating The Dealer," S. DeWitt Clough; "Planning a Campaign," Frederick A. Farrar.

Stenographic reports of the meetings are taken and transcripts furnished the various members of the organization.

The other officers for the ensuing three months are Vice-Chairman, Mr. Frederick A. Farrar; Secretary, Mr. G. G. Place.

TRADE NOTES.

The Oakland Traction Co., Consolidated, has purchased from the General Electric Co. 60 two-motor car equipments with type K 36 controllers. The motors are 60 h.p. each.

Reckhill & Victor, of Shanghai, China, have ordered from the Westinghouse Electric & Manufacturing Company a 150 h.p. alternating current, induction, slip ring motor, and a water rheostat to be used in operating a flour mill.

Through Shewan, Thomas & Company of Pekin, the Chinese Government has purchased two 150 kw. direct current generators and a nine-panel switchboard from the Westinghouse Electric & Manufacturing Company, Pittsburg, Pa. The generators will be installed in the Bureau of Engraving and will supply power for motors and lights.

NEWS NOTES

INCORPORATIONS.

COALINGA, CAL.—The Coalinga Domestic Water Company has been incorporated with a capital stock of $10,000 by F. Cheney, C. N. Sanderson and R. L. Peeler.

LONG BEACH, CAL.—The Long Beach Water Company has been incorporated by G. H. Bixby, a director of the Alamitos Water Company.

SPRINGDALE, WASH.—The Chamokane Contracting Company has been organized to construct an electric railroad between this place and the proposed power plant of the Washington Water Power Company on the Spokane River.

FINANCIAL.

SILVERTON, ORE.—This city has voted to issue bonds to the amount of $75,000 to be used for the construction of a water system.

WILLOWS, CAL.—The City Trustees have decided that on March 1st, the bonds recently voted for municipal improvements will be sold. Immediately after the disposal of the bonds work will be commenced on the city hall, which is to cost about $25,000.

TRANSMISSION.

TOPPENISH, WASH.—The Valley Light and Power Company is extending its lines to Zillah, Wash.

POCATELLO, IDAHO.—Flood waters in the Portneuf River wrecked the substation and transformer house of the Idaho Consolidated Power Company here.

PETALUMA, CAL.—The proposed gas plant for the city to take the place of the "Piped from Santa Rosa" gas for this city is now assured and work will be under way within a very short time.

VALE, ORE.—Plans are under way whereby within two months Vale will be connected with the power plant on the Malad River, Idaho. The plant belongs to the Telluride Company, Salt Lake City.

VANCOUVER, WASH.—The Mt. Hood Railway & Power Company has asked a franchise to erect poles, string wires and furnish power in the city. Plans are under way to lay a cable under the Columbia from this place to Portland.

LOS ANGELES, CAL.—The Navidad Mines & Reduction Company in San Sebastian district at Jalisco will soon install a hydroelectric plant on Ameca River capable of generating 800 horsepower. The plant will cost about $150,000.

LODI, CAL.—At the meeting of the Merchants' Association last week A. V. Friedberger, W. H. Thompson, and S. H. Zimmerman, were appointed a committee to interview the business men of this place regarding the proposed street lighting system.

WATSONVILLE, CAL.—In the proper spirit of expansion The Coast Counties Light & Power Company of this city is extending its power lines in this valley. In Green Valley the line will be extended three miles to the Litchfield place about seven miles from this city.

PORTLAND, ORE.—Bids will be received at the office of Bridges & Webber, architects, room 422 Hamilton building, Portland, Oregon, until 10 a. m., February 19, 1911, for the erection of a main building and power house for Multnomah County, at Multnomah Farm, one mile west of Troutdale, Ore.

MARTINEZ, CAL.—Light, heat and power are to be furnished the towns of the county and the manufactories along the water front by the Great Western Power Company, which has signified its intention to enter Contra Costa County by applying to the Martinez trustees for a franchise. The new corporation, since its organization has carried its electric power from the Sierra to the bay cities along the main line, which stretches across Contra Costa County. The only local service which the company has given is at the works of the Cowell Cement Company at the base of Mt. Diablo.

COLUSA, CAL.—For the purpose of furnishing water sufficient to irrigate 40,000 acres of land in Colusa County, west of Williams, and to generate electric power, three water appropriations have been filed by Byron D. Beckwith of this city on Freshwater and Bear creeks, Colusa County, and on Cache Creek in Lake County. It is proposed to build a dam on Bear Creek and utilize the lower end of Bear Valley as a reservoir. A tunnel through the hill from Bear Valley into the head of Freshwater Creek to divert the water past Mountain House, utilizing it at the outlet of the tunnel for the production of power, is planned. Below the Mountain House the same water would be used for irrigation. Three power stations, all on one line, are proposed.

ILLUMINATION.

SPRINGFIELD, ORE.—The Oregon Power Company plans to make Springfield and Junction City models for street lighting. The new lighting will be a tungsten system.

NEWPORT, CAL.—The City Council passed a resolution declaring that public interest demands the erection of a municipal light plant in this city and $55,000 in bonds will be issued to cover the cost of the plant.

REDLANDS, CAL.—City Engineer Hinckley has completed plans for installing a system of ornamental street lighting on Orange street from Colton and on Cajon to Olive and on State, Second and Citrus avenue, from Third to Sixth street, at a cost of $15,000.

PASCOL, WASH.—The Pacific Power & Light Company has petitioned the City Council for vacation of a portion of Riverside addition which will be secured by this corporation for a site for a $400,000 electric switchboard and gas plant, to be constructed in the near future.

TRANSPORTATION.

SPOKANE, WASH.—The Spokane Traction Company during the year will build 2½ miles of new street railway.

WHITTIER, CAL.—The Pacific Electric Railway Company will double track its line on West Philadelphia street to the State school.

COEUR d'ALENE, IDAHO—Eastern capital will ask the city for a franchise for the construction of an electric street railway here.

COEUR d'ALENE, IDAHO.—The Inland Empire railroad will soon extend the tracks of their electric railroad to the shores of Fernon lake.

SAN RAFAEL, CAL.—A petition has been presented by Geo. D. Shearer, asking for a franchise to operate an electric railroad over the streets of this city.

OAKLAND, CAL.—A bill has been passed to print granting the Oakland Traction Company a franchise for a street railroad along and upon Nineteenth avenue.

RAYMOND, WASH.—J. D. Crary of the Twin City Electric Company has accepted the franchise for the construction of an electric street railway system here; work to start in April.

PUYALLUP, WASH.—R .S. Boyce of Hopokus, N. J., is sounding valley capitalists and property owners on the support they will give toward the construction of another interurban line between this place and Tacoma.

LOS ANGELES, CAL.—Property owners on Main street, from Thirty-seventh street, to Manchester avenue, have filed a petition asking the City Council to induce the street railway company to run car tracks down their street.

ALAMEDA, CAL.—The Southern Pacific has begun placing poles in Clement avenue to carry power from the tidal canal to the termination of the loop line in Webster street. The work will be rushed in order to have the power ready when the Alameda local lines are electrized.

LOS ANGELES, CAL.—The Los Angeles Railway Company has applied for a franchise for a crosstown car line. Two routes have been submitted; one from Fourth and Vermont to east city limits, the other on Vermont to Jefferson, east to Central, south to Vernon and east to the city limits.

PORTLAND, ORE.—Bids will be received by Engineers Smith, Kerry & Chace, 611 Commercial building, for clearing the right of way on the Mt. Hood Railway Power Company's transmission line across the Sandy River valley. Work consists of clearing 22 acres and to be completed May 1. Specifications may be obtained from the office of the Mt. Hood Railway & Power Company, at Portland.

LOS ANGELES, CAL.—Announcement of the operation under one management of the Pacific Electric, Los Angeles and Redondo, Redlands Central and Riverside and Arlington Railway Companies and of the Los Angeles Pacific and San Bernardino Traction Companies is made in a circular issued from the Los Angeles office of Paul Shoup, vice-president of the Southern Pacific, owner of the several properties, and director of its electric railways.

MARTINEZ, CAL.—The Oakland and Antioch Railroad is to be extended to the slopes of Mount Diablo, in accordance with the agreement of the officers of the corporation to haul the rock to be quarried from the Martin ranch, which is to be purchased by the Spreckels company of San Francisco. It was first reported that the San Francisco concern was to establish a cement plant on the ground, but it is now announced that a quarry is to be built.

PETALUMA, CAL.—The City Council has granted to the Petaluma and Santa Rosa Electric Railroad Company a franchise to operate a line through the city. The company agreed in its franchise that if the road was not completed to Point Pedro within four years from the date of the granting, with ferries running to San Francisco, the franchise will lapse. The object of the railroad company is to build to Point Pedro and connect with San Francisco by fast ferries. The line will be operated on Water street, skirting on the river banks, which the company will improve and save the city of Petaluma over $10,000.

FRESNO, CAL.—F. S. Granger, vice-president, and W. D. Mitchell, secretary of the Fresno, Hanford and Summit Lake Railroad Company have returned from New York bringing with them signed contracts from the Hudson Counties Construction Company and Guaranty Trust Company of New York by which $1,250,000 has been secured to build an interurban railroad from Fresno to Kingsburg with a branch to Sanger. The road will be 35 miles long. The contract was signed January 28 and provides that construction shall start within 30 days. William McLean, chief engineer of the Hudson Counties committee, is en route to Fresno and immediately upon his arrival work will be started.

SACRAMENTO, CAL.—Vice-President John A. Britton of the Pacific Gas & Electric Company has agreed to build the loop as suggested by property owners along the proposed line from Twenty-eighth and P streets to the Elmhurst railway provided a bonus, the exact amount of which has not been made public, is paid to the street railroad company. The plan is to construct a line, starting at Twenty-eighth and P streets, running to the east end of Homestead through the Williamson tract and into Elmhurst.

SAN FRANCISCO, CAL.—The public utilities committee of the Board of Supervisors has recommended that an additional $600,000 of Geary street railroad bonds be offered for sale. The action was taken upon notification from the city engineer's office of the Board of Public Works that $600,000 would be soon needed that the work on the municipal project may not be delayed. The proposals for early construction and the amounts to be expended are as follows: Special track work $60,000; lands for power house and substation, $140,000; cars, $300,000; track construction and overhead work, $300,000; construction of buildings, $80,000; total, $880,000. Out of the proceeds of $500,000 of bonds already sold, $218,000 has been set aside to cover part of the above estimates, leaving $600,000 needed for immediate use.

SAN FRANCISCO, CAL.—The United Railroads Company has issued a report of the gross earnings of the street railway system for December last and for the year 1910. The document shows in part that the company during last year carried 153,069,780 paying passengers. This is an increase of 3,850,480 passengers over the preceding year, a gain which is considered a healthy one and indicative of the general good condition of the city. Put in another way, this large travel means that last year the United Railroads system had a daily average of 419,370 paying passengers and a monthly average of 12,755,817. In December last the company earned gross $682,356, or an increase of $36,509 over the same month in 1909. For the twelve months of 1910 the gross earnings amounted to $7,653,489, as compared with $7,455,965 the year before. This represents an increase of $197,524.

WATERWORKS.

REDMOND, ORE.—The City Council is considering the question of building a gravity water system.

MADERA, CAL.—The City Trustees have adopted plans and specifications for an overhead water system.

CHICO, CAL.—The Chico Water Supply Company has submitted to the Trustees its annual report showing an investment of $175,834.28; receipts of $25,600.53, and expenditures of $30,260.94.

SEATTLE, WASH.—The Council has passed a resolution providing for the improvement of West Eightieth street, West Eighty-first street, and West Eighty-second street, West Eighty-third street and West Eighty-fourth street by laying water mains.

BRAWLEY, CAL.—Within ten days, the first work will commence on the new water system of the city, the contract having been signed with G. A. Rogers of Los Angeles. This city will also purchase the system installed here by the Brawley Water Company.

FRESNO, CAL.—The annual statement of the water company for the year 1910, filed with the City Trustees, shows as earnings and expenses of the company the following figures: Earnings: Water furnished, $113,365.20; miscellaneous, $1,521.49; fixed charges, $82,938.72; net earnings, $31,947.97. Value of plant, less depreciation for 1910 at rate of 3.26, $274,228,63; expenditures for extensions and improvements, $9,542.07; value of plant $263,770.70.

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Jonesboro, Indiana.

J

Johns-Manville Co., H. W.
New York, 100 William.
San Francisco, 159 New Montgomery.
Los Angeles, 222-224 North Los Angeles St.
Seattle, 576 1st Ave. So.

K

Kellogg Switchb'd & Supply Co.
Chicago.
San Francisco, 88 First.

Kelman Electric & Mfg. Co. 4
Los Angeles, Cal.

Kiewert, Chas. L. Co. 5
San Francisco, 195-7 Fremont.
Los Angeles, 225 Franklin Court.

Klein & Sons, Mathias 16
Chicago, Station U-29.

L

Locke Insulator Mfg. Co.
Victor, N. Y.
San Francisco, Monadnock Bldg.
Los Angeles, Pacific Electrical Bldg.
Seattle, Colman Bldg.

M

Moore, Chas. C. & Co. Engineers. 3
San Francisco, 99 First.
Los Angeles, American Bank Bldg.
Seattle, Mutual Life Bldg.
Portland, Wells-Fargo Bldg.
Salt Lake City, Atlas Blk.
New York City, Fulton Bldg.

N

New York Insl'td Wire Co.
New York, 114 Liberty.
San Francisco, 770 Folsom.
Seattle, 416 American Bank Bldg.

O

Ohio Brass Co. 5
Mansfield, Ohio.
San Francisco, Monadnock Bldg.
Los Angeles, Pac. Electric Bldg.
Seattle, Colman Bldg.

Okonite Co. 16
New York, 253 Broadway.

P

Pacific Gas & Elect. Co., The 2
San Francisco.

Pacific Meter Co. 13
San Francisco, 311 Santa Marina Bldg.

Pacific Tel. & Tel. Co., The
San Francisco.

Partrick Carter & Wilkins Co.
Philadelphia, 22d and Wood

Pelton Water Wheel Co., The 13
San Francisco, 2219 Harrison st.

Phillips Insulated Wire Co. 16
Pawtucket, R. I.

Pierson, Roeding & Co. 4
San Francisco, Monadnock Bldg.
Los Angeles, Pac. Electric Bldg.
Seattle, Colman Bldg.

Portland Wood Pipe Co. 5
Portland, Ore.

R

Reisinger, Hugo
New York, 11 Broadway.

S

Schaw-Batcher Co. Pipe Works
Sacramento, Cal., 211 J St.
San Francisco, 356 Market.

Southern Cal. Edison Co.
Los Angeles, Cal.

Southern Pacific Co. 15
San Francisco, Flood Bldg.

Sprague Electric Co. 2
New York City, 527-531 W. 34th.
San Francisco, Atlas Bldg.
Seattle, Colman Bldg.

Standard Und. Cable Co. 16
San Francisco, First National Bank Bldg.
Los Angeles, Union Trust Bldg.
Seattle Office, Lowman Bldg.

Star Expansion Bolt Co.
New York City, 147-149 Cedar.
San Francisco, 1010 Howard.

Sterling Paint Company, 13
San Francisco, 118 First.

T

Technical Book Shop 12
San Francisco, 604 Mission.

Thomas and Sons Co., R. 11
New York, 227 Fulton.
East Liverpool, Ohio.

Thompson Co., The Chas. C.
Chicago, 545-549 Wabash ave.

Tracy Engineering Co. 13
San Francisco, 461 Market.
Los Angeles, Central Bldg.

W

Wagner Electric Mfg. Co.
St. Louis, Mo.

Western Electric Co. 5
San Francisco, 680 Folsom.
Oakland, 507 16th.
Los Angeles, 119 E. 7th
Seattle, 1518 First Ave. So.

Western Wireless Equipment Co. 5
San Francisco, Grant Bldg. 7th and Market.

Westinghouse. Elec. & Mfg. Co. 6
Pittsburg, Pa.
Los Angeles, 527 So. Main.
Denver, 429 17th.
Seattle, Central Bldg.
Salt Lake City, 213-214 So. W. Temple.
San Francisco, 165 2d.
Spokane, Columbia Bldg.
Portland, Couch Bldg.
Butte, Lewisohn Bldg.
Canada, Canadian-Westinghouse Co., Ltd., Hamilton, Ontario.
Mexico, G. & O., Braniff & Co., City of Mexico.

Westinghouse Machine Co.
Pittsburg, Pa.
San Francisco, 141 Second.

Weston Elect'l. Instrument Co. 16
Waverly Park, N. J.
New York, 114 Liberty.
San Francisco, 682-684 Mission.

Wilbur, G. A. 3
San Francisco, 61 Second.